D11.3 Report on Standardization, Dissemination and Exploitation Activities II

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1) Summary

This deliverable covers the activities related to exploitation and standardisation of the project, and also the key aspects of the dissemination strategy implemented in the second reporting period year. The three aspects mentioned before are detailed with respect to the progress reported in D11.2 (the first report on standardization, dissemination and exploitation) following a similar general structure.

Dissemination has been continued actively, in all fronts, with research publications, industry awareness actions and announcements focused on the general public. The new phase in the project implies a different pattern for dissemination, especially in what relates to activities other than research conferences or peer-reviewed publications. The initial focus on announcing the project start and plans has transformed into more mature reports on results and early exploitation activities. In the standards arena, the team had successfully dealt with the growing interest of many bodies on quantum technologies and kept our position as one of the main references for QKD standardization.

2) Introduction

The commitment made by CiViQ to demonstrate QKD, and in particular CV-QKD, maturity and integrability with network services operational practice has strengthened as the project evolved, in despite of the additional hurdles for these activities we have unfortunately experienced in the last months. As said in our precedent deliverable, D11.2, the project has continued considering impact in the widest possible sense, including the general, research, and industrial aspects, with special attention to the maximization of the economic impact, as well as the analysis of the ethical and social implications of the technological advance enabled by the project. The growing awareness about the applications of Quamtum Technologies, and QKD as the closest to market availability, has been of great help in increasing the project impact in all aspects, though in some cases has been as well the source of what we could call *thermal noise*: the typical excess of announcements and expectations around a hot technology topic. The project team has dedicated effort to clarify our message and make it distinct among this increasing noise level. The coming sections describe the results of this impact creation activities during the second period of the project, as an update of the report provided in D11.2.

First, the standardization activities of the CiViQ team will be presented, showing the continuation of the project involvement in several key standards initiatives in which CiViQ contributions have become instrumental. As said above, a number of new proposals for standardization actions were made, both within the bodies already working in QKD and within new ones. The project team has been specially focused on avoid unnecessary duplication and maximize the application of CiViQ results across the different initiatives, fostering the reuse of existing specification and trying to prevent redundancies and overlaps among the active bodies, or even within different groups of the same body.

As some partners, especially the industrial ones, have gained a better understanding of use cases, requirements, and future market opportunities, they have refined the exploitation plans originally described in the project proposal and further refined in D11.2. This deliverable includes a report of such updates, including those partners that have improved them during this period.

Finally, communication and dissemination activities are also reported. This includes, on the one hand, the refinement of CiViQ presence mechanisms, mostly online, including all the activities related to the project communication identity, improving the channels described in D11.2 to maximize awareness at all levels.

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On the other, they include the concrete actions taken to build awareness about the project results within all potentially interested communities. As reported in D11.2 as well, these actions range from the scientific publications essential to a research flagship project like CiViQ to dissemination at industry-related events, fundamental for achieving the economic and social impact the project is aiming at.

The project team will continue the activites for a successful impact creation, evaluating of further opportunities and improving current practices to maximize the dissemination of project results and their influence on further research and industry consolidation.

3) Standardization

The evolution of the work in design (especially around WP2, WP3 and WP8) has allowed the CiViQ consortium to continue making significant contributions in different standardization bodies, not only consolidating the activities already reported for the first period, but also addressing new initiatives. As said above, the group has not only focused on bringing project results to the relevant bodies, but also in rationalizing these activities, in an attempt of miniziming fragmentation and overlapping. The standardization work has been mainly addressed by a team supported by the partners identified in D11.2 (HWDU, TID and UPM), with the addition of OR.

3.1) ITU-T

The standards team has actively followed and contributed to the QKD work in SG13 (*Future Networks*) on network requirements to support QKD, and SG17 (*Security*), on the applicability of QKD technologies to enhance we have led and contributed tp a workgroup in the newly created Focus Group on Quantum Information Technologies for Networks (FG-QIT4N), intended to align ITU-T activities on quantum technologies.

In addition, in SG15 (*Transport, Access and Home*), two contributions were made to Question 13 on synchronization, in order to motivate the creation of a study item on synchronization for QKD networks.

3.2) ETSI

The standards team has focused its activity in the ETS ISG QKD on work related to SDN and interfaces, both to applications and among QKD node components. Further a comparative analysis of QKD (and general Quantum Coomunication) networks was carried out, aiming to identify a generic architecture where the logical interfaces and the flow of information among the components are pinpointed and thus to guarantee open operation and foster disaggregation The requirements and testing of QKD internal technology elments was also investigated. A central target was the security of QKD and specifically the practical security of the technology. ETSI supportsed the first world-wide certification process of QKD (developing the first QKD Common Criteria Protection Profile) in collaboration with BSI (the German Federal Office for Information Security). Two members of the project standards team (from HWDU and UPM) currently hold vice-chair positions in the group. Specifically, last summer the new version for the PDL004 specification for key extraction was approved. By the turn of the year, PDL015, on the SDN control interface, was also approved. These specifications are key elements in the QKD application software stack. Further approvals are pending in 2021.

Using the results in the ETSI ISG QKD as foundation, the team has continued building awareness on the CiViQ activities at ETSI TC-CYBER, ETSI ISG NFV, ETSI ISG PDL and ETSI ISG SAI, regarding use cases relevant

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for general cyber-security practices and their application to relevant fields such as virtualization, distributed ledgers and AI.

3.3) IETF/IRTF

The team has continued its contributions related to the project results, mainly focused on the QIRG (Quantum Internet Research Group), leveraging the experience in QKD network operation and management to derive a better understanding of the requirements for a future Quantum Internet, and the network and component abstractions analyzed in WP2, 3 and 8 as the foundations for the Quantum Internet nodes. Work has continued as well in the integration of SDN-based key management defined in I2NSF (Interface to Network Security Functions) with the SDQKDN approach defined by CiViQ. Finally, the integration of SFC (Service Function Chaining) proof-of-transit mechanisms with QKD is planned as a use case to be demonstrated within the project.

3.4) CEN/CENELEC

The project standards team has participated in the definition and scoping of the newly created CEN/CENELEC Focus Group on Quantum Technologies, coordinating the sections on Quantum Communications and on Use Cases, and making active contributions in others and supporting the development of the general (European) Quantum Technologies Road Map.

The team made use of this leadership positions to reinforce the message of standards alignment, avoiding fragmentation among bodies and initiatives and fostering the reuse of already available significant specifications. It also participated in the harmonization of work between CEN-CENELEC and ITU-T.

3.5) GSMA

The report on standardization activities in D11.2 mentioned a study being performed by the GSMA Internet Group (IG) on quantum technologies. The document, titled “Quantum Computing, Networking and Security” and about to be published, received several contributiuons from the standards team, including a presentation on the component-based model for QKD nodes.

The GSMA interest on the application of quantum technologies to mobile networks continues, and the discussion on the scope of a new document concluded recently with an agreed charter for it, with the title “Quantum Networking and Services”. The project standards team led the discussion on scoping the issues related QKD, operational aspects and the integration with classical networks.

4) Industrial and Academic Exploitation

This section updates the exploitation steps taken to date by those partner that has adapted them in the light of the recent results at all levels: use case analysis, requirements, architectures, initial proofs of concept, etc. The exploitation updates are organized by partner type.

4.1) Industrial Exploitation

4.1.1) Mellanox (MLNX)

Mellanox is offering a broad range of networking equipment for HPC and cloud datacenters and is well established as a supplier of premium equipment for a broad range of applications, offering industry-leading bandwidth and latency. Five out of six top global banks are using Mellanox equipment; the same occurs for 9 out of top 10 hyperscale companies, 9 out of top 10 oil and gas companies, 3 of top 5 pharmaceutical companies and 10 of top 10 automotive companies.

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In the majority of the DC applications, cryptography is playing an increasingly critical role. In this context Mellanox views QKD as the absolute technology that can offer fundamentally superior encryption capabilities to its network products and is therefore strongly interested in incorporating this technology into its offerings.

Mellanox is keen to push the limits of the Bluefield DPU (Data Processing Unit) product family towards enabling new functionalities with added value to its customers, underpinning the company's profile as a pioneer in its field. The impact to Mellanox if successful to integrate this technology in its offerings is expected to be of the order of hundred million USD, affecting a broad range of applications and channeled through different market collaborations.

Within the project Mellanox aims to implement a proof-of-concept QKD enabled link based on the Bluefield network adapter, derive requirements for interfacing with the project's QKD hardware and perform an investigation for the implemention of the project's QKD stack on the Bluefield DPU and on an NVIDIA GPU. Mellanox targets first, to provide "QKD-enabled" equipment to its customers and second, to extend the offloading capabilities of its products by including the processing required for realizing QKD enabled links.

After the end of the project Mellanox envisions a follow-up R&D activity where the custom QKD optics will be integrated into pluggable transceivers in collaboration with key partners within the project. Following the proof-of-concept combination of QKD optics with the QKD-capable Bluefield network adapter, Mellanox will consider the suitable model for the commercialization of the technology (e.g. licensing the technology from the partners involved, participating in a joint venture etc.).

4.1.2) Quside (QS)

As part of the CiViQ project, Quside is primarily working on the development and validation of a photonic integrated circuits (PIC) for high speed quantum random number generators (QRNG). Quside is also developing a low-cost QRNG based on off-the-shelf components for early stage system developers.

Quside has identified the following immediate exploitation opportunities during this period:

Description of expected result	Exploitable know-how	Exploitation plan	Beneficiaries
QRNG modules (up to 10 Gb/s) following the standard QRNG-CV-QKD-system interface	Know-How related to QRNG components for high speed CV-QKD systems and their interfacing.	Marketing of fast QRNG modules for (i) the open development platform (ODP) marketplace to allow people build systems in a "do-it-yourself" basis and (ii) manufacturing and supplying of QRNG OEM modules to CV-QKD system developers that will supply to end users. Standardisation of the interfacing for the QRNG component for CV-QKD systems.	CV-QKD system integrators, industrial and academic partners.
Compact QRNG Modules for CV-QKD systems, adapted in size, interface and performance.	Know-how on development of QRNG components at high performance, compact form factors, dedicated physical and data interfaces.	Supply of QRNG components to CV-QKD system makers and standardization activities for QRNGs. A QRNG module for the ODP will also be commercially supported by Quside if the architecture gets demand.	CV-QKD system integrators, industrial and academic partners.

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4.1.3) Nextworks (NXW)

Nextworks main activities in the CiViQ project are focused on the Software Defined Control plane for QKD devices and their seamless integration into already existing legacy optical network infrastructures. The know-how derived from these activities is strategic for the company at both tecnological and business levels.

For what concerns the technology expertise, Nextworks holds already a strong know-how in the control of optical networks through SDN-based solutions and the pariticipation in the CiViQ project represents a concrete opportunity to exend its background knowledge towards new advanced topics in the field of SDN control for highly secured communications and QKD technologies. In practice, when combined with the company expertise in the area of NFV and 5G network slice orchestration, it enables the realization of new software products for the realization of secure virtualized service chains and avoid building own security mechanisms to increase trustwithiness in SDN/NFV environments. The concrete application and exploitation of CiViQ outcomes is planned to result in free open-source QKD-based software solutions to be integrated with the exisiting company's SDN/NFV stack and showcased at private and public events in order to attract new customers and extend the current company portfolio in the market of 3rd party custom software developments and advanced training courses. Several consultancy activities focused on SDN/NFV techonology field are indeed currently available in the Nextworks offer and the aim of the company is to consolidated it with new training tracks and software products aligned with the SDN for QKD topics covered in CiViQ. This is also true for what concern the activities in standardization fora, where Nextworks actively contributes and pariticpates into several ETSI ISGs initiatives (including NFV, MEC, ZSM, OSM), including development and showcase of Proof of Concepts. All of these activities are planned to benefit from the network of contacts the company aims to acquire and extend through the participation in CiViQ, by exploiting the internal collaboration with the other partners involved in the project, expecially telco operators and QKD device vendors and manufacturers for which Nextworks can design and develop customized software solutions for unified SDN network control with integration of QKD capabilities.

4.1.4) Telefónica (TID)

TID continues with its plan for the exploitation of CiVIQ results, based on the integration of CV-QKD in telecommunication infrastructures and their operationalization with the support of SDN techniques. TID has made a wide dissemination of QKD technologies and their applicability to different use cases among the different Business Units of the Group, with special emphasis on those providing connectivity services to corporate customers and cloud services, as they are the ones expressing a highest interest in QKD applications.

This steps has allowed TID to consolidate the environment for QKD technology demonstration, through the optical network deployed in Madrid (the MQN, *Madrid Quantum Network*) with the strategic collaboration of UPM. The network has expanded, connecting to the 5G demonstration testbed 5TONIC (http://www.5tonic.org/), what has allowed for the demonstration of applicability of QKD in 5G and edge computing scenarios. The recent integration of the 5TONIC testbed with a demonstration facility at Telefónica headquarters will eventually support further pilots and field trials with the innovation ecosystem around the Wayra initiative.

A new set of field trials, extending those described in D11.2 was planned for Q4 2020, though the lockdowns due to the pandemics have delayed their execution. The TID, UPM and HWDU teams are working to perform them within this quarter.

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4.1.5) Orange (OR)

At the beginning of the CiViQ project, Orange has worked with the other partners of the project to define use-cases (with DT and TID in WP2) and the related top level specifications of the QKD systems (with the partners of WP3).

Orange's first use-cases are more business customer-oriented in order to offer very high security services to customers which have to transport sensitive data. Indeed, some customers need very long term security as their data can be related to national security, health, finance… In those cases, it is admitted that current key exchange protocols can be attacked by very efficient computers (i.e. quantum ones). With the combination of QKD and OTP encryption for example, long term confidentiality is facilitated at the transmission level.

As the current QKD systems have some limitations in terms of total reach/loss we choose access network range use-cases to offer the possibility not to resort to trusted nodes in all cases. These use-cases can be classified in three main topologies namely:

- Point-to-point
- Point-to-multipoint
- Multipoint-to-multipoint

Orange is also involved in the OPENQKD project and in this context is continuing to define real use-cases and their translation into operational networks requirements for deployment of secured networks and services with the QKD technologies.

The defined use-cases take into account co-propagation of the QKD channel with the customer signal channel. Moreover, the challenge lies in the possible coexistence of QKD channel with bidirectional transmission (downstream and upstream transmissions over the same fiber) which is implemented in point-to-multipoint systems and in point-to-point systems.

Due to the COVID outbreak, the work planned for the last year has been delayed. However, Orange has started the experimental work by first focusing on coherent emission-reception and Digital Signal Processing. This work will continue during the next part of CiViQ; the intention is to work on Digital Signal Processing (DSP) for the quantum channel. This work is based on Orange skills on coherent signal processing: the specific QKD test-bed will be connected to the already existing laboratory test tools to evaluate the quantum communication channel co-propagating with WDM channels. This would eventually allow defining new algorithms for the compensation of specific non-linear impairments affecting the CV-QKD channel (i.e. SRS: Spontaneous Raman Scattering). More particularly, specific DSP dedicated to the CV-QKD channel will be implemented because this one imposes severe constraints due to the weakness of the power sent on the coherent detector.

The fact that the principles of quantum physics can be used to provide other cryptographic building blocks than key distribution is also a possibility for Orange to exploit CiViQ's outputs. Some results in the related work have shown that there are some reasons to think that we may be able, in the future, to design some commitment schemes and some homomorphic operations over encrypted data using a combination of

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quantum and standard cryptography. During the second part of the project, Orange will therefore study some of these cryptographic building blocks in relation to its internal needs, as a telecom operator.

Finally, during the project, the real features and limitations of the CV-QKD solution and the maturity and the potential of the proposed components/sub-systems/systems for industrial applications will be evaluated by performing evaluation of QKD prototype(s) in the laboratory and/or on a field fiber.

Orange has identified the following immediate exploitation opportunities during this period:

Description of expected result	Exploitable know-how	Exploitation plan	Beneficiaries
Advanced Digital Signal Processing to perform channel equalization in CV-QKD	Expected foreground: know-how and IPR in advanced Digital Signal Processing to perform channel equalization in CV-QKD	• Definition of real use-cases and their translation into operational networks requirements for deployment of secured networks. with the CV-QKD technologies. • New algorithms for the compensation of non-linear effects on Digital Signal Processing. • New cryptographic algorithms. Evaluation of the QKD prototype.	Business units in Orange and other telecom operators
New cryptographic algorithms	New cryptographic algorithms, based on quantum physics, methods on CV-QKD evaluation and test equipment		

4.2) Academic Exploitation

4.2.1) Institute of Photonic Sciences (ICFO)

ICFO is continuously exploring the best strategy to protect the potential IP generated during the execution of the project. Once an innovation is identified, the Knowledge and Technology Transfer unit (KTT) evaluates its marketable potential and elucidates what is the best protection strategy for that specific asset. For most of the IP assets, ICFO will preferably file a patent application, whenever possible. Other protection tools (trade secrets, utility models, etc) are considered as well, when appropriate.

For ICFO, the main exploitable results currently identified within CiViQ's project execution are:

i. **CV-QKD transmitter and receiver:** ICFO owns background proprietary know-how, including the background EP/PCT patent EP19382139.4 filed on 27/02/2019 and started a patent filing process on a system control method, partially funded with the project.

ii. **Novel QKD arquitecture, related systems and components:** ICFO has filed a recent patent application EP/PCT 20383141.7 filed on 22/12/2020, also partially funded with the project.

The different commercialization routes for ICFO's IP portfolio and technology package have being analysed in detail. ICFO aims to create a spin-off company (LuxQuanta Technologies S.L.) to commercialize QKD hardware and software components and systems throught the exclusive license of the corresponding IP portfolio. The spin-off will seek investment, and liaise with system integrators, network providers and potential clients.

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4.2.2) Austrian Institute of Technology (AIT)

AIT is and will be evaluating the potential commercialisation of a CV-QKD system or parts of it through an external distributor throughout the project. In December 2020 AIT sold a SW license for a post-processing stack for CV-QKD system using QPSK modulation to the Max-Planck-Institute for the Science of Light. This SW was successfully used in a QKD demonstration in the framework of the German national research initiative QuNET.

In the first half of 2021 AIT will license a similar SW but for CV-QKD systems using Gaussian modulation to the MPL.

Since January 2021, AIT is responsible for quantum technologies assessment (including CV-QKD protocols and technology for space) in one of the three SAGA Phase A studies of ESA on the space part of the EuroQCI.

4.2.3) Universidad Politecnica de Madrid (UPM)

As a university focused on technology, UPM has been collaborating with the industrial partners in the definition of use cases and the corresponding top level specifications (WP2 and WP3). The main purpose is to help with a smooth transition between the final use cases and its implementation and testing. Making sure that the network components, for which UPM is the WP leader (WP8) support a correct integration in the infrastructure, as well as the corresponding testing.

During CiViQ part of a software stack for QKD network integration based on Software Defined Networking has been developed. This stack has received attention from the European Comission Innovation Radar, and UPM, together with Telefónica and Nextworks are considered key innovators. In their study, the EC determined that the software addresses market needs. Also, the team at UPM has been engaged with several university programs (e.g InnovaTec) designed to bring innovations to the market. As a result, the group is considering the commercial potential of these developments.

The developments are based on standards that the UPM has also contributed to create at ETSI and that have been recently approved. Standardization is of great help in transitioning from research to technology, and for this reason, UPM has been very active in the standardization front (working with ETSI, ITU-T, IEEE-SA and CEN/CENELEC)

The outputs are helping to build the ecosystem to support the CiViQ vision of developing technology as a solution to real industrial needs. Transforming research into technology that solves problems is the mission of a university like UPM.

4.2.4) Institut Mines-Telecom (TPT)

TPT is conducting CV-QKD system development in WP7, searching on system designs capable of jointly performing classical coherent communication and CV-QKD. This research action (TRL2-3), focuses on multiplexing, coexistence capability and cost reduction (shared hardware) and we target a demonstration in the lab of our joint classical -quantum integration by M34.

TPT has also developed a novel idea: Covert CV-QKD, and will target a demonstration in the lab by M38, and possibly a demonstration over a fiber link connecting Telecom Paris and Orange Labs in Châtillon by the end of the project, or in the following months.

In WP6, a preprint demonstrating how attack rating can be used in the context of QKD security vulnerability analysis (https://arxiv.org/abs/2010.07815) has been recently published. This work has already been presented within ETSI QKD ISG in December 2020 and contributes to the important international effort towards the standardization of QKD security evaluation. TPT also point at some challenges, related to

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formalization of QKD security and believe that the ongoing work on QKD implementation security and certification, will also trigger novel developments towards a renewed cryptographic positioning of QKD.

In WP9 TPT has proposed a new security model for quantum cryptography, relying on a hybrid set of assumptions: noisy quantum storage and short-term computational security (https://arxiv.org/abs/2004.10173). A publication by M32 is targeted, together with a (partial) lab demonstration, relying on multimode spectral encoding, by M38.

In WP8 TPT is working on a framework for optical functions in networks, including CV-QKD, capable of expressing their physical properties and requirements. It is anticipated that systematizing the handling of QKD and other optical functions will enable their large-scale integration into networks.

4.2.5) Centre National de la Recherche Scientifique (CNRS)

CNRS as an academic partner is focusing on journal publications and conference presentations on the research outcomes of the project, regarding in particular CV-QKD security proofs (WP6), new generation of CV-QKD components and systems (WP4 and WP7), and protocols beyond QKD (WP9). CNRS will also examine potential exploitation of joint results with industry partners throughout the project.

4.3) Joint Exploitation Activities

Joint exploitation commonly refers to exploitation opportunites that involve more than one partner, as a result of the collaboration within the project. As the project has evolved, two of these opportunities has appeared, and we do hope several others will arrive in the coming months.

NXW, TID and UPM identified an opportunity related to the operationalization of QKD networks and the applicability of SDN to combine best practices in classical an quantum networks. This has been recognized and registered by the CNECT Innovation Radar as *Software Stack for the integration of different QKD devices into a real production Software Defined Network*.

Furthermore, the collaboration and knowledge sharing within the project has facilitated the involvemnent of several partners in activities related to the EuroQCI initiative. Several partners have contributed to the *EuroQCI Industrial Roadmap*, and seven of them (AIT, CNRS, DT, MPL, TID, UPM and UPOL, with ICFO and TPT in the review board) participated in the QCI4EU study, analyzing the current and foreseeable quantum networking landscape, and producing several documents with recommendations for the future deployment of the EuroQCI.

5) Dissemination and Communication

CiViQ has fostered collaborations with academia, industry and other representative groups to ensure its results are well known by all the stakeholders that are relevant to the project. The team has ensured visibility of the project in the EU research landscape, and developed cooperative relationships with related projects, with special consideration of the relationship with the European Quantum Flagship.

5.1) Online Presence, Social Media and Communication Actions

Firstly, the CiViQ website https://civiquantum.eu/ was developed and has been on-line since November 2018, right after the launch of the project. It is the main communication channel used by the consortium to share all information regarding the project with specialized audiences as well as the public at large. The project website has been continuously updated with all relevant information about the project, its goals and achievements, as well as any news or media coverage related to the project or the partners of the consortium.

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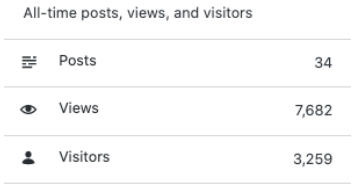
During this second year, the following communication actions summarized in the following sections have been carried out.

It is worth to highlight that, due to the pandemic situation, the planning of the several major communication actions addressed for this project were completed hinder and in most cases cancelled. We were expecting a major participation in the Mobile World Congress (Feb 2020), which was cancelled, as well as a communications campaign for all projects during the EQTC 2020 (Nov 2020) also postponed, for the moment, to the end of 2021.

5.1.1) CiViQ Website

Since its creation, the CiViQ website has generated over 34 posts, having a total of 7,682 views of the website and 3,259 visitors:



The total amount of views of the CiViQ website can be broken down as follows:

Since November of 2019 to December of 2020, the analytics regarding the CiViQ website visits can be viewed below:

Description	11/2019 – 12/ 2020
Posts	16
Views	7243
Avg. Session Duration	1m 27s
Bounce rate	61.54%

Visits per country between these dates are:

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5.1.2) Press-Media Impacts

Through this period of time, the project CiViQ has been mentioned in the following media outlets:

Media Outlet	Title	Link	Date
cincodias.com	¿Acabarán los ordenadores cuánticos con la criptografía tradicional?	https://retina.elpais.com/retina/2020/10/26/innovacion/1603743705_577788.html	27/10/2020
elpais.com	¿Acabarán los ordenadores cuánticos con la criptografía tradicional?	https://retina.elpais.com/retina/2020/10/26/innovacion/1603743705_577788.html	26/10/2020
El País	CAMINO DE LA INTERNET CUÁNTICA	T065 (printed)	24/10/2020
lavanguardia.com	De la ciencia al mercado: cuántica al servicio de la ciberseguridad	https://www.lavanguardia.com/economia/20201024/484144141815/quside-icfo-fotonica-ciberseguridad.html	23/10/2020
La Vanguardia	Ocho empresas nacidas del ICFO	D16 (printed)	18/10/2020
La Vanguardia en català	Vuit empreses nascudes de l'ICFO	D16(printed)	18/10/2020
Ouest-France	Orange Labs imagine les verrous numériques du futur	https://www.ouest-france.fr/bretagne/lannion-22300/lannion-orange-labs-imagine-les-verrous-numeriques-du-futur-6900829	09/07/2020
"Hello Future" @ Orange website	Orange and the quantum technologies for the security of data exchange	https://hellofuture.orange.com/en/orange-and-the-quantum-technologies-for-the-security-of-data-exchange/	22/062020

The following table provides a list of international media outlets for the second period:

Date	Title	Media outlet	Region	Audience	Link
03/03/2020	EU scientists think they've found a way to make the internet 'unhackable' – here's what that means	Trusted Reviews	Europe	5.070.000	https://www.trustedreviews.com/news/eu-scientists-think-theyve-found-a-way-to-make-the-internet-unhackable-heres-what-that-means-3990278
25/02/2020	EU Consortium to Prevent Quantum Cyberattacks	Photonics. Com	international	155.820	https://www.photonics.com/Articles/EU_Consortium_to_Prevent_Quantum_Cyberattacks/a65575
24/02/2020	New encryption to prevent quantum cyber-attacks	Digitalisation World	Europe	82.150	https://digitalisationworld.com/news/58612/new-encryption-

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					to-prevent-quantum-cyber-attacks
24/02/2020	EU-funded project promises unhackable quantum encryption	EE News Europe	Europe	78.980	https://www.eenewseurope.com/news/eu-funded-project-promises-unhackable-quantum-encryption
25/02/2020	New Encryption to Prevent Quantum Cyber-Attacks	AZO Optics	international	55.000	https://www.azoquantum.com/News.aspx?newsID=6877
26/02/2020	New quantum encryption for secure transmission and sensitive information	ELE Times	Europe	53.550	https://www.eletimes.com/new-quantum-encryption-for-secure-transmission-and-sensitive-information
24/02/2020	New encryption to prevent quantum cyber-attacks	New Tech Europe	Europe	49.500	https://www.new-techeurope.com/2020/02/24/new-encryption-to-prevent-quantum-cyber-attacks/
24/02/2020	New encryption to prevent quantum cyber-attacks	Tech Mezine	Europe	45.128	https://www.techmezine.com/top-10-news/new-encryption-prevent-quantum-cyber-attacks/
25/02/2020	European quantum team plans optical encryption trial this year	Optics	international	45.000	https://optics.org/news/11/1/83
24/02/2020	Quantum Technology Flagship Encryption May Prevent Cyber-Attacks	Novus Light	international	28.654	https://www.novuslight.com/quantum-technology-flagship-initiative-develops-encryption-to-prevent-cyber-attacks_N10132.html
03/03/2020	New Encryption to Prevent Quantum Cyber-Attacks	Photonics Views	Europe	26.877	https://www.photonicsviews.com/new-encryption-to-prevent-quantum-cyber-attacks/
26/02/2020	EU's €1 Billion Quantum Technology Flagship Developing Quantum Encryption Protocols To Secure Internet	Inside Quantum	Europe	20.000	https://www.insidequantumtechnology.com/news/eus-e1-billion-quantum-technology-flagship-developing-quantum-encryption-protocols-to-secure-internet/
24/02/2020	New encryption to prevent quantum cyber-attacks	PBSI	Europe	18.500	http://www.pbsionthenet.net/article/177015/New-encryption-to-prevent-quantum-cyber-attacks.aspx
26/02/2020	European quantum team plans optical encryption trial this year	I-Micro News	Europe	17.560	https://www.i-micronews.com/european-quantum-team-plans-optical-encryption-trial-this-year/

The following table summarizes all media impact obtained during this period, from both national (Spanish based media clipping service) and international coverage

Description	National	International
Number of media pieces	6	20
Audience (amounts of viewers)	5.964.524	5.746.719

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Estimated Value (€)	63.692€	-

NOTE: The clipping service used by the project covers mainly Spanish handles

A complete listing of the news items at the CiviQ website can be found at https://civiquantum.eu/news-events/.

5.1.3) Audio-Visual Material

The first video (PlayGround format) created for the project aimed at giving an overview of how cybersecurity and cryptography are of utmost importance in this world of today where daily operations of businesses, administrations and individuals rely on the manipulated of data that needs to be protected. This video presents the current existing technologies and how CiViQ will develop flexible and inexpensive Quantum Key Distribution (QKD) systems that be easily integrated into current telecom infrastructures.

In addition to this introductory video, we have created two more videos. The first one has been focused on trying to show why large operators are showing interest in quantum technologies, what the project can offer and how SMEs and industry are planning a essential role in the supply chain of quantum techonologies development

The first video has been uploaded to the YouTube and Vimeo platforms while the latter two have been promoted mainly on Youtube, within the Quantum Flagship youtube channel:

Title	Link (YouTube & Vimeo)	Date	Imp	I/C rate	Vs	Uvs
CiViQ's industry, SMEs and large operators	https://youtu.be/q6hT5ogK1yo	16/11/2020	1.3K	2.6%	238	141
CiViQ_ Quantum Key Distribution to secure our communications – Interview with Eleni Diamanti	https://www.youtube.com/watch?v=FWKv-CoilAs&t=3s	21/12/2020	707	4.4%	208	166
The CiviQ Project	https://www.youtube.com/watch?v=jVmfWpk0Ldg	07/03/2019	4.2K	4.9%	636	-
	Link to the CiViQ video in Vimeo	07/03/2019	-	-	183	26

(Imp = Impressions, I/C rate= impression through click rate, Vs = Views, UVs = Unique Views)

VLC Photonics was present at the SPIE Photonics West event in San Francisco, hold from the 1st to 6th February 2020 but no further active participating in photonic trade shows and events was possible due to COVID pandemic. Instead, VLC drove for public visibility through online dissemination of the EU H2020 CIVIQ project along writing generalist articles about current CIVIQ progresses in the company website[1] and for magazines oriented to photonics and quantum optical communications sector.

[1] https://www.vlcphotonics.com/tag/civiq/

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In addition, VLC has been speaker in a few webinars and presentations related to quantum communications where CIVIQ was mentioned. Among those, the SECPHO webinar "Who is who. Integrated Optics" on 22th May 2020[2], and the SECPHO webinar on "Quantum technologies reaching the market" on 06th April 2020[3], are of most relevance.

5.1.4) Social Media

Taking into account that the duration of the project is three years and because many of the institutions involved in the project have shown to have a considerable number of followers in their accounts (see information in the Deliverable Dissemination and Exploitation Plan), the CiViQ project has taken advantage of these consolidated accounts to communicate its evolution thru these handles.

Bearing this in mind, we have used a hashtag to identify the project: #CiViQ_quantum. In some occasions, the #CiViQ hashtag has also been used. By doing a follow-up of these, we have able to track all information being disseminated through the different social media accounts that we have used.

The following table summarizes the activity that we have created for the CiViQ project in social media outlets. Twitter, by far has been the social media channel that we have used, due to the type of news and posts that we have been creating to give visibility to the project.

Social media	Number of Posts	Number of Impressions
Twitter	50	1.059.200
Linkedin	19	12.360
Facebook	3	2.011
TOTAL	**72**	**1.073.571**

In particular, Jennifer Aldama, researcher at ICFO and partner of the project, has participated in the campaign "Quantum Reads", promoted by the Quantum Flagship during the confinement in April of 2020. The flagship initiative carried out a campaign aimed at sharing and promoting the reading of popular science books about Quantum Physics with the goal of engaging the followers of the account to read about the topic and helping popularize the field amongst the general public.

We include a snapshot of the twitter link:

[2] https://www.secpho.org/en/actoagenda/who-is-who-en-fotonica-integrada/
[3] https://www.secpho.org/en/actoagenda/first-quantum-technologies-coming-to-the-market/

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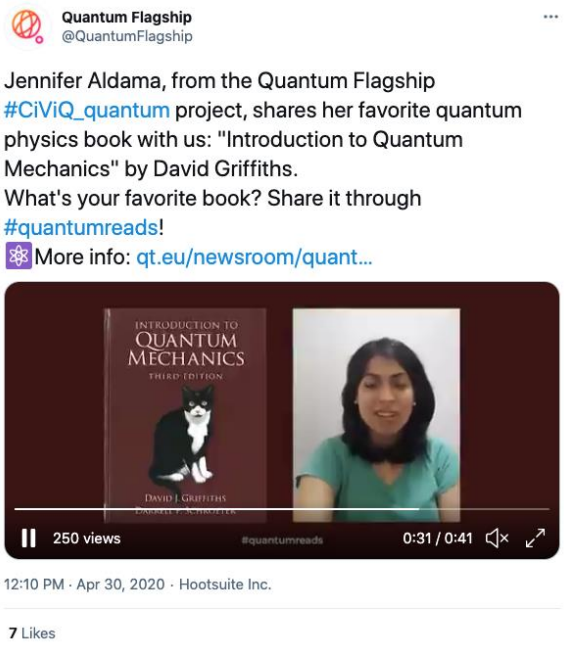

The table below lists the tweets that were posted in reference to the project. As a note, the analytics provided by the different platforms does not provide detailed information about the external handles, thus we simply list the links of the posts:

Tweet permalink	time	impressions	engagements	retweets	likes
https://twitter.com/QuantumFlagship/status/1342797316672147456	2020-12-26 11:40 +0000	18930	18.0	0	60
https://twitter.com/QuantumFlagship/status/1329449382731788288	2020-11-19 15:40 +0000	15200	12.0	0	20
https://twitter.com/QuantumFlagship/status/1328684435617746948	2020-11-17 13:00 +0000	14180	13.0	0	20
https://twitter.com/QuantumFlagship/status/1328253761589030912	2020-11-16 08:29 +0000	15130	20.0	0	60
https://twitter.com/QuantumFlagship/status/1323959878306668546	2020-11-04 12:06 +0000	30380	17.0	20	30
https://twitter.com/QuantumFlagship/status/1320994950453014530	2020-10-27 07:45 +0000	50930	120.0	100	240
https://twitter.com/QuantumFlagship/status/1320440068071444488	2020-10-25 19:00 +0000	78620	211.0	140	220
https://twitter.com/QuantumFlagship/status/1318824505356201985	2020-10-21 08:00 +0000	33930	70.0	70	140
https://twitter.com/QuantumFlagship/status/1318250687508119552	2020-10-19 18:00 +0000	16280	38.0	10	70
https://twitter.com/QuantumFlagship/status/1316649531136708608	2020-10-15 07:58 +0000	5940	23.0	10	10
https://twitter.com/QuantumFlagship/status/1316302855091953665	2020-10-14 09:00 +0000	28650	45.0	50	130
https://twitter.com/QuantumFlagship/status/1316269373066227713	2020-10-14 06:47 +0000	30930	67.0	80	150
https://twitter.com/QuantumFlagship/status/1306503478794223617	2020-09-17 08:01 +0000	12990	14.0	0	60
https://twitter.com/QuantumFlagship/status/1304434914000072713	2020-09-11 15:01 +0000	12580	8.0	0	0
https://twitter.com/QuantumFlagship/status/1303710213120364545	2020-09-09 15:01 +0000	11280	15.0	0	10

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https://twitter.com/QuantumFlagship/status/1302985319994851328	2020-09-07 15:01 +0000	13390	23.0	0	30
https://twitter.com/QuantumFlagship/status/1296719305925709824	2020-08-21 08:02 +0000	13420	17.0	10	50
https://twitter.com/QuantumFlagship/status/1279339459423744000	2020-07-04 09:01 +0000	17170	10.0	0	30
https://twitter.com/QuantumFlagship/status/1278600144242475009	2020-07-02 08:03 +0000	16230	18.0	0	40
https://twitter.com/QuantumFlagship/status/1277980533809655808	2020-06-30 15:01 +0000	15380	20.0	20	40
https://twitter.com/QuantumFlagship/status/1262668106939457538	2020-05-19 08:55 +0000	17310	32.0	30	20
https://twitter.com/QuantumFlagship/status/1261602315066376195	2020-05-16 10:20 +0000	13860	19.0	0	20
https://twitter.com/QuantumFlagship/status/1260480054888468480	2020-05-13 08:00 +0000	14430	45.0	0	30
https://twitter.com/QuantumFlagship/status/1255801595272540160	2020-04-30 10:10 +0000	17980	56.0	0	70
https://twitter.com/QuantumFlagship/status/1255119720178647045	2020-04-28 13:00 +0000	18670	27.0	50	10
https://twitter.com/QuantumFlagship/status/1253232435921387521	2020-04-23 08:01 +0000	13350	30.0	0	40
https://twitter.com/QuantumFlagship/status/1248298456004931584	2020-04-09 17:15 +0000	11480	8.0	0	0
https://twitter.com/QuantumFlagship/status/1246437522848219136	2020-04-04 14:00 +0000	19480	9.0	0	20
https://twitter.com/QuantumFlagship/status/1239460053956034560	2020-03-16 07:54 +0000	13860	2.0	0	10
https://twitter.com/QuantumFlagship/status/1234765741821435909	2020-03-03 09:01 +0000	12460	19.0	10	80
https://twitter.com/QuantumFlagship/status/1233316025363509248	2020-02-28 09:00 +0000	19590	19.0	10	50
https://twitter.com/QuantumFlagship/status/1232703165411266561	2020-02-26 16:25 +0000	18310	15.0	10	20
https://twitter.com/QuantumFlagship/status/1230044371153756165	2020-02-19 08:20 +0000	25040	18.0	20	50
https://twitter.com/QuantumFlagship/status/1219543936852791296	2020-01-21 08:55 +0000	14680	19.0	0	50
https://twitter.com/QuantumFlagship/status/1210108187677999105	2019-12-26 08:00 +0000	19600	32.0	30	50
https://twitter.com/QuantumFlagship/status/1207934001232719873	2019-12-20 08:01 +0000	17210	16.0	10	40
https://twitter.com/QuantumFlagship/status/1205034865663631361	2019-12-12 08:01 +0000	18440	13.0	10	40
https://twitter.com/QuantumFlagship/status/1202498133202292736	2019-12-05 08:01 +0000	21580	37.0	50	60
https://twitter.com/QuantumFlagship/status/1197921433239859200	2019-11-22 16:55 +0000	21170	19.0	40	100
https://twitter.com/QuantumFlagship/status/1178565469122502657	2019-09-30 07:01 +0000	35300	70.0	100	180
https://twitter.com/ICFOnians/status/1272780877718867968	2020-06-16 06:39 +0000	24760	62.0	50	160
https://twitter.com/ICFOnians/status/1304435092610338816	2020-09-11 15:02 +0000	11350	21.0	20	50
https://twitter.com/ICFOnians/status/1303710162285465605	2020-09-09 15:01 +0000	9510	16.0	10	40
https://twitter.com/ICFOnians/status/1320821851879284736	2020-10-26 20:17 +0000	4050	5.0	0	10

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https://twitter.com/ICFOnians/status/1324010781957128199	2020-11-04 15:29 +0000	15380	60.0	30	160
https://twitter.com/ICFOnians/status/1322833919507599360	2020-11-01 09:32 +0000	17390	84.0	30	190
https://twitter.com/ICFOnians/status/1322485270206423040	2020-10-31 10:27 +0000	13750	57.0	30	170
https://twitter.com/ICFOnians/status/1322169835938349057	2020-10-30 13:33 +0000	21570	105.0	90	250
https://twitter.com/ICFOnians/status/1321874135505666050	2020-10-29 17:58 +0000	29110	192.0	90	270
https://twitter.com/ICFOnians/status/1319541651879170048	2020-10-23 07:30 +0000	20810	20.0	10	20
https://twitter.com/ICFOnians/status/1319541651510087680	2020-10-23 07:30 +0000	20890	115.0	80	100

5.2) Publication and Talks

The following table summarizes talks and presentations at different scientific and industrial conferences and events

Partner(s)	Date	Venue	Title / Reference(s)
DTU	03/11/2019	Copenhagen	NOVO quantum life,
DTU	14/11/2019	Lyngby	Danish Optical Society Meeting
UPOL	20/11/2019	Grenoble	European Quantum Technology Conference
DTU	21/11/2019	Copenhagen	Danish-Japanes conference focusing on collaboration in quantum technology
DTU	22/11/2019	Copenhagen	Quantum Hub Denmark
CNRS	23/11/2019	Lisbon	Lecture at Gulbenkian Foundation School
ICFO	28/11/2019	Barcelona	Talk on “Learning the Physics of Quantum Systems Using Photonic Quantum Simulators” by Raffaele Santagati
OR	29/11/2019	Lannion	Optical Networks program seminar in Orange Labs facilities
CNRS	03/12/2019	Paris	Contributed talk at COAT Workshop
UY	13/12/2019	London	QuEST/QOLS seminar at Imperial College
UPM, CNRS	17/12/2019	Tokyo	Topical Conference on Quantum Communication and Security 2019
DTU	01/10/2020	Copenhagen	Talk on “Continuous Variable Quantum Cryptography” at Danish Quantum Technology Meeting
CNRS	28/01/2020	Paris	General public conference at Cité des Sciences (
NXW	01/02/2020	Barcelona	Panel poster and company dissemination material Quantum Technologies space in the “Deep Tech EU” zone of the MWC2020
VLC	06/02/2020	San Francisco	SPIE Photonics West 2020
UY	14-21/02/2020	Trieste	Winter College on Optics: Quantum Photonics and Information, International Centre for Theoretical Physics (ICTP)
TPT	28/02/2020	Geneva	Lecture at IdQuantique Winter School on CV-QKD
TPT	09/03/2020	San Diego	Invited Talk at OFC 2020
CNRS	11/03/2020	Virtual	Round table at BPI France Cybersecurity event
AIT	20/03/2020	San Diego	OFC 2020
TPT	24/03/2020	Virtual	Invited Talk RISQ Posi-Quantum Cryptography Project
VLC, QS, TID	06/04/2020	Virtual	SECPHO webinar on “Quantum technologies reaching the market”
ICFO	19/05/2020	Virtual	2020 International Conference on Optical Network Design and Modeling (ONDM)

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UPM	18-21/05/20	Virtual	24TH INTERNATIONAL CONFERENCE ON OPTICAL NETWORK DESIGN AND MODELLING: Invited Tutorial: Enabling quantum networking via Software-Defined Networking: integration and use cases
VLC, QS	22/05/2020	Virtual	SECPHO webinar "Who is who. Integrated Optics"
CNRS	10/06/2020	Virtual	Invited talk at the European Dialogue on Internet Governance (EuroDIG)
UPM, HWDU	10/06/2020	Virtual	ETSI - ITU Joint meeting. Presentation "Quantum Network Architectures"
INR	10/08/2020	Virtual	invited talk at QCrypt 2020, "Security proofs for continuous-variable quantum key distribution": https://2020.qcrypt.net/sessions/invited_leverrier/
CNRS	11/08/2020	Virtual	Invited tutorial at QCrypt
AIT, TUD	11/08/2020	Virtual	QCrypt Poster: "Two MET-LDPC codes designed for long distance CV-QKD"
AIT	11/08/2020	Virtual	QCrypt Poster: "AIT QKD Post Processing and Network Software"
AIT	12/08/2020	Virtual	QCrypt Poster: "Open European Quantum Key Distribution Testbed"
AIT	13/08/2020	Virtual	QCrypt Poster: "Standardization and Certification of QKD-Devices and QKD-Networks"
CNRS	21/09/2020	Virtual	Caltech INQNET seminar
CNRS	29/09/2020	Virtual	Orange Business Model seminar
DTU	30/09/2020	Virtual	Panel discussion on "quantum key distribution" at Quantum Computing Summit Silicon Valley 2020
UPM	20/10/2020	Virtual	15 Jornadas REDIMADRID. Invited presentation "The Madrid Quantum Network"
ICFO	29/10/2020	Virtual	Inside Quantum Technology Conference
TPT	03/11/2020	Virtual	Talk on QKD and PQC, Crisis Security Workshop
ICFO, CNRS	04/11/2020	Virtual	European Quantum Week
QS	11/11/2020	Virtual	EPIC Online Technology Meeting on Quantum Communication & Quantum Key Distribution
ICFO	19/11/2020	Virtual	Conference - Tecnologies quàntiques: què passa quan els bits esdevenen quàntics. Institut d'Estudis Catalans
UPM	28/11/2020	Virtual	Innovatech Final (UPM technology challenge)
CNRS	02/12/2020	Virtual	Cybersecure MIT Tech Review event

And the following table summarizes the journal publications made by the project partners during the reported period

Partner(s)	Author(s)	Title	Journal	Link to repository
UPOL, MPL	Olena Kovalenko, Kirill Yu. Spasibko, Maria V. Chekhova, Vladyslav C. Usenko, Radim Filip	Feasibility of quantum key distribution with macroscopically bright coherent light	Optics Express, 10.1364/oe.27.036154	https://www.osapublishing.org/oe/abstract.cfm?uri=oe-27-25-36154
UPOL, MPL	László Ruppert, Christian Peuntinger, Bettina Heim, Kevin Günthner, Vladyslav C Usenko, Dominique Elser, Gerd Leuchs, Radim Filip, Christoph Marquardt	Fading channel estimation for free-space continuous-variable secure quantum communication	New Journal of Physics, 10.1088/1367-2630/ab5dd3	https://iopscience.iop.org/article/10.1088/1367-2630/ab5dd3
UY	Masoud Ghalaii, Carlo Ottaviani, Rupesh Kumar, Stefano Pirandola, Mohsen Razavi	Long-Distance Continuous-Variable Quantum Key Distribution With Quantum Scissors	IEEE Journal of Selected Topics in Quantum Electronics, 10.1109/jstqe.2020.2964395	https://arxiv.org/abs/1808.01617
UY	Masoud Ghalaii, Carlo Ottaviani, Rupesh Kumar, Stefano Pirandola, Mohsen Razavi	Discrete-Modulation Continuous-Variable Quantum Key Distribution Enhanced by Quantum Scissors	IEEE Journal on Selected Areas in Communications, 10.1109/jsac.2020.2969058	https://arxiv.org/abs/1907.13405

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ICFO	Stefan Bäuml, Koji Azuma, Go Kato, David Elkouss	Linear programs for entanglement and key distribution in the quantum internet	Communications Physics, 10.1038/s42005-020-0318-2	https://www.nature.com/articles/s42005-020-0318-2
UY	Carlo Ottaviani, Matthew J. Woolley, Misha Erementchouk, John F. Federici, Pinaki Mazumder, Stefano Pirandola, Christian Weedbrook	Terahertz Quantum Cryptography	IEEE Journal on Selected Areas in Communications, 10.1109/jsac.2020.2968973	https://arxiv.org/abs/1805.03514
UY	Kyungjoo Noh, Stefano Pirandola, Liang Jiang	Enhanced energy-constrained quantum communication over bosonic Gaussian channels	Nature Communications, 10.1038/s41467-020-14329-6	https://doi.org/10.1038/s41467-020-14329-6
DTU	J. Arnbak, C. S. Jacobsen, R. B. Andrade, X. Guo, J. S. Neergaard-Nielsen, U. L. Andersen, T. Gehring	Compact, low-threshold squeezed light source	Optics Express, 10.1364/oe.27.037877	https://www.osapublishing.org/oe/abstract.cfm?uri=oe-27-26-37877
UY	Kieran N. Wilkinson, Thomas P. W. Cope, Stefano Pirandola	Exploring the Limitations of Quantum Networking through Butterfly-Based Networks	Advanced Quantum Technologies, 10.1002/qute.201900103	https://arxiv.org/abs/1909.02342
CNRS, INR	Shouvik Ghorai, Eleni Diamanti, Anthony Leverrier	Composable security of two-way continuous-variable quantum key distribution without active symmetrization	Physical Review A, 10.1103/physreva.99.012311	https://arxiv.org/pdf/1806.11356.pdf
AIT	Dinka Milovančev, Nemanja Vokić, Fabian Laudenbach, Christoph Pacher, Hannes Hübel, Bernhard Schrenk	Spectrally-Shaped Continuous-Variable QKD Operating at 500 MHz Over an Optical Pipe Lit by 11 DWDM Channels	Optical Fiber Communication Conference (OFC) 2020, 10.1364/ofc.2020.t3d.4	https://doi.org/10.1364/OFC.2020.T3D.4
DTU	Darko Zibar, Hou-Man Chin, Yeyu Tong, Nitin Jain, Joel Guo, Lin Chang, Tobias Gehring, John E. Bowers, Ulrik L. Andersen	Highly-Sensitive Phase and Frequency Noise Measurement Technique Using Bayesian Filtering	IEEE Photonics Technology Letters, 10.1109/lpt.2019.2945051	https://orbit.dtu.dk/en/publications/highlysensitive-phase-and-frequency-noise-measurement-technique-u-2
UPM, TID, HWDU	A. Aguado, D. R. López, A. Pastor, V. López, J. P. Brito, M. Peev, A. Poppe, V. Martín	Quantum cryptography networks in support of path verification in service function chains	Journal of Optical Communications and Networking, 10.1364/jocn.379799	http://www.gcc.fi.upm.es
ICFO	R. Valivarthi, S. Etcheverry, J. Aldama, F. Zwiehoff, and V. Pruneri	Plug-and-play continuous-variable quantum key distribution for metropolitan networks	Optics Express, 10.1364/OE.391491	https://www.osapublishing.org/oe/fulltext.cfm?uri=oe-28-10-14547&id=431338
ICFO	J. Kołodynski, A. Máttar, P. Skrzypczyk, E. Woodhead, D. Cavalcanti, K. Banaszek, and A. Acín	Device-independent quantum key distribution with singlephoton sources	Quantum, 10.22331/q-2020-04-30-260	https://quantum-journal.org/papers/q-2020-04-30-260/
UPM	A. N. Pinto, L. Ortiz, M. Santos, A. C. Gomes, J. P. Brito, N. J. Muga, N. A. Silva , P. Mateus, and V. Martin	Quantum enabled private recognition of composite signals in genome and proteins	2020 22nd International Conference on Transparent Optical Networks (ICTON), 10.1109/ICTON51198.2020.9203042	https://ieeexplore.ieee.org/document/9203042

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UPM, TID, HWDU	V. Martin; D. Lopez; A. Aguado; J. P. Brito; J. Setien; P. Salas; C. Escribano; V. Lopez; A. Pastor-Perales; M. Peev	A Components Based Framework for Quantum Key Distribution Networks	2020 22nd International Conference on Transparent Optical Networks (ICTON), 10.1109/ICTON51198.2020.9203181	https://ieeexplore.ieee.org/document/9203181
UPM, TID	Ruben B. Mendez; Juan P. Brito; Rafael J. Vicente; A. Aguado; Antonio Pastor; Diego Lopez; V. Martin; Victor Lopez	Quantum Abstraction Interface: Facilitating Integration of QKD Devices in SDN Networks	2020 22nd International Conference on Transparent Optical Networks (ICTON), 10.1109/ICTON51198.2020.9203073	https://ieeexplore.ieee.org/document/9203073
UPM, TID, HWDU	Lopez, Diego R. and Martin, Vicente and Lopez, Victor and de la Iglesia, Fernando and Pastor, Antonio and Brunner, Hans and Aguado, Alejandro and Bettelli, Stefano and Fung, Fred and Hillerkuss, David and Comandar, Lucian and Wang, Dawei and Poppe, Andreas and Brito, Juan P. and Salas, Pedro J. and Peev, Momtchil	Demonstration of Software Defined Network Services Utilizing Quantum Key Distribution Fully Integrated with Standard Telecommunication Network	Quantum Reports, 10.3390/quantum2030032	https://www.mdpi.com/2624-960X/2/3/32
UPM, TID	A. Aguado, V. López, J. P. Brito, A. Pastor, D. R. López and V. Martin	Enabling Quantum Key Distribution Networks via Software-Defined Networking	IEEE Xplore; Procceedings 24th International Conference on Optical Network Design and Modeling (ONDM 2020), 10.23919/ONDM48393.2020.9133024	http://dl.ifip.org/db/conf/ondm/ondm2020/1570640302.pdf
UPOL	Ivan Derkach, Vladyslav C. Usenko, and Radim Filip	Squeezing-enhanced quantum key distribution over atmospheric channels	New Journal of Physics, 10.1088/1367-2630/ab7f8f	https://iopscience.iop.org/article/10.1088/1367-2630/ab7f8f
UPOL	Vladyslav C. Usenko, and Akash nag Oruganti	Role of anti-squeezing noise in continuous-variable quantum cryptography	IEEE proceedings of the 43rd International Conference on Telecommunications and Signal Processing, 10.1109/TSP49548.2020.9163561	https://ieeexplore.ieee.org/abstract/document/9163561
UY, DTU, UPOL	S. Pirandola, U. L. Andersen, L. Banchi, M. Berta, D. Bunandar, R. Colbeck, D. Englund, T. Gehring, C. Lupo, C. Ottaviani, J. Pereira, M. Razavi, J. S. Shaari, M. Tomamichel, V. C. Usenko, G. Vallone, P. Villoresi, P. Wallden	Advances in Quantum Cryptography	Advances in Optics and Photonics, 10.1364/AOP.361502	https://arxiv.org/abs/1906.01645

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UY, DTU	K. N. Wilkinson, P. Papanastasiou, C. Ottaviani, T. Gehring, S. Pirandola	Long-distance continuous-variable measurement-device-independent quantum key distribution with postselection	Physical Review Research, 10.1103/PhysRevResearch.2.033424	https://journals.aps.org/prresearch/abstract/10.1103/PhysRevResearch.2.033424
DTU	D. Zibar, U. C. Moura, H. M. Chin, A. M. Rosa Brusin, N. Jain, F. Da Ros, S. Kleis, C. Schaeffer, T. Gehring, U. L. Andersen, A. Caren	Advancing classical and quantum communication systems with machine learning	Optical Fiber Communication Conference (OFC), Optical Society of Amperica, Paper W1K.1, 10.1364/OFC.2020.W1K.1	https://www.osapublishing.org/abstract.cfm?uri=OFC-2020-W1K.1
DTU, UY	T. Gehring, C. Lupo, A. Kordts, D. Solar Nikolic, N. Jain, T. Rydberg, T. B. Pedersen, S. Pirandola, U. L. Andersen	Homodyne-based quantum random number generator at 2.9 Gbps secure against quantum side-information	Nature Communications, 10.1038/s41467-020-20813-w	
CNRS, INR	Daniele Dequal, Luis Trigo Vidarte, Victor Roman Rodriguez, Giuseppe Vallone, Paolo Villoresi, Anthony Leverrier, Eleni Diamanti	Feasibility of satellite-to-ground continuous-variable quantum key distribution	NPJ Quantum Information, 10.1038/s41534-020-00336-4	https://arxiv.org/abs/2002.02002

6) Conclusions

This deliverable has reported the standardization, dissemination and exploitation activities carried out in the CIVIQ project during its second year. In despite of the complex situation caused by the COVID pandemics, the project has strengthened its general communication tasks, the number and quality of scientific publications, and the presence in academic and industrial events. The standards team has consolidated its deep standardization footprint, extended field trials and demonstrators, and advanced in technology transfer.

We believe this confirms the feasibility and potential for impact of the CiViQ proposal, that we anticipate the first report made in D11.2.

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