Deliverable – D5.2 External Communication Plan

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Authors	Johannes Svensson, Lund University
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Contents

Introduction

This document was developed as part of the **SEQUENCE –** Cryogenic 3D Nanoelectronics (Sense and Readout Electronics Cryogenically Integrated for QUantum ENhanced Computation and Evolving Communication) project funded by the European Union Horizon 2020 Framework Programme (H2020-ICT-2019-2) under the grant agreement no. 871764.

> *The overall objective of SEQUENCE is to make use of Unconventional Nanoelectronics to develop cryogenic electronics and demonstrate their usability and effectiveness for quantum computing systems.*

The plans for the external communication where outlined in the SEQUENCE proposal. The reason to place an update to the external communication plan at an early stage in the project, is that the partners were aware that there is typically 8 months between a proposal submission and a project start date. With this in mind, we placed an early deliverable within SEQUENCE in the area of External Communication to account for any changes in the intervening period, and also to update the communication plan based on the discussions at the kick off meeting in Lund University, Sweden (January 2020). Due to COVID-19 this deliverable was delayed until Feb 2021 to take the current situation into acount.

Based on discussions at the kick off meeting in Lund University and the present COVID-19 situation, some updates to the communication plan were proposed and discussed. These proposals were agreed by the SEQUENCE management committee.

The present Deliverable is part of the deliverables of Work Package 5. D5.2 is a non-confidential document to be made public.

SEQUENCE External Communication Plan (ECP)

The dissemination of knowledge and expertise between the partners is built into the work package structure and project management and has been reported in the deliverable D6.5 “Internal Communication Plan”. It is noted that, the issues of “internal communication channels, “the SEQUENCE logo”, “SEQUENCE templates”, “security” and “continuous improvement”, are also covered in the SEQUENCE Deliverable 6.5.

Original Plans for External Communication

The overall aim of the External Communication in relation to project is to ensure the maximum visibility of the EU funded project to Industry, the Scientific Community and to European Citizens.

The original plans for external communication as outlined in the proposal and detailed below.

Dissemination and Communication to a Non-Technical Audience

This activity is central to the dissemination as it plays a critical role in explaining the importance of Nanoelectronics and Quantum Technologies to a broad range of applications, which have a big impact on the everyday lives of people in Europe, spanning the use of advanced semiconductor technologies in communications, health care, and the environment both now and into the future. This area of dissemination is also important to explain and justify to the broader public why it is essential for the European Union to invest in research into the next generation of technologies. Also, sustainable innovation in the field of quantum electronic technologies is dependent on encouraging and attracting talented young people into the field.

The SEQUENCE project will take the following measures in explaining our work and attracting the next generation of talented young people into the field.

- We will work with dedicated personnel at Lund University to make videos to communicate our research work and its significance to the broader public. These videos can be used in a variety of ways, such as: uploaded to Youtube, used as short clips on “EuroNews”, presentation at the EuroNanoForum and many more. It will also serve as a very good introduction during the Industrial Road Show. The videos will also be made available for use by the European Commission. This video can also be used for outreach to schools and for communicating the significance and achievements of the work to local and national politicians
- We will engage **social media** to deliver to the widest audience a simplified and attractive message on the benefits of EU-funded research. Some of the partners (IBM, T-UCC, IAF) already have in place an active policy to advertise the activities of researchers through direct links to social media platforms (Facebook, Linkedin, Twitter, Flickr, Youtube, and blogging platforms).
- SEQUENCE members will actively participate in **outreach events** targeted towards students and secondary school students. **IBM** is very active in reaching out in different ways to high school students to attract them to science and technology (e.g. “Science week”, researcher visits at high schools, “Swiss Tech Day”, etc.). **IBM** also regularly hosts University student groups for presentations and lab visits. Every year in February **T-UCC** hosts Transition Year students (typically 16-17 year olds) for one week. **T-UCC** also contributes to the Discovery Science Festival in Cork, and now hosts undergraduate students from the field of Digital and Creative Media to develop outreach videos as well as information graphics to communicate scientific results. **GLA** regularly contribute to UK national science festivals to disseminate

the outputs of their work to the general public. **IAF** has a YouTube Channel and is active in other social media as well. The **IAF** has a public relations department which supports press releases and social media, exhibitions and internal communication within Fraunhofer and their alliances, but also marketing of key products and research results. **ULUND** every year hosts visiting High-School students interested in Science and Technology (Gemstone project, NMT days and Her Tech Future). **ULUND** also plan to participate in "Culture night", a science/culture outreach event for the general public.

- Several members of the consortium are regular professors and lecturers at universities. Those channels will be used to communicate and raise awareness of the SEQUENCE technologies, transfer knowledge to advanced courses, and attract master and PhD students for research in this field.

Dissemination to Industry

The SEQUENCE consortium will attend appropriate **Conferences/Exhibitions** like the **European Microwave Week** to make contact with relevant industries. Stake holders with interests in Cryogenic electronics, space applications as well as future communication systems will be identified.

SEQUENCE will prepare a **press release,** which will coincide with the web site launch. The press release will be sent to relevant industries in Europe, where the partners have existing personal contacts. (such as, Intel mobile (Germany), ST (France), Analog Devices (Ireland), Global Foundries (Germany)) It will also be distributed within the channels of the Quantum Technology Flagship.

Two dedicated workshops will be organized by the SEQUENCE consortium during the project to highlight the technology platform which is being developed by the SEQUENCE consortium and how it can be of benefit to European Industry. The workshops will be by invitation and will be run in parallel with appropriate European events, such as the ESSDERC or the European Microwave Week**.** One of the workshops will be an **International Workshop**, deepening the relations to the research and development in the US and in Asia. In particular, the workshops will emphasize the benefits of the SEQUENCE technology platform, which are:

- Cryogenic electronics for quantum computing
- Cryogenic electronics for high-performance computing
- Space communication and sensing
- Future communication systems.

In the preparations of the workshops, we will use our network of industrial stake holders and the networks towards other EU-funded consortia. They will play a key role, as they will be invited to participate and share their perspective on the technology evolution.

The SEQUENCE consortium will also attend **brokerage events** organized within the framework of EU Ecsel projects (https://www.ecsel.eu) towards the end of the project. In addition, we will have a strong effort during the project to continuously refine and strengthen the dissemination of SEQUENCE and its outcomes to the industry, this includes defining a plan for beyond the project. One key strategy will be our Industrial Roadshow (task 5.7) that is used as a two-way communication strategy with both dissemination of and collection of input to the consortia. *Our targeted dissemination efforts will respond to the EU request to prepare the industry for future developments of the electronic landscape.*

Dissemination to the Scientific Community

For dissemination to the research community active in nanoelectronics, we will take the following approaches:

a) The traditional channels of **publications and conferences** will be utilized as a means to expose our results to our peers, to get critical feedback on the impact of the project and foster the field. In line with the recent research record of the consortium members we will target a broad spectrum of the top international conferences and leading journal publications in the field. The decision to disseminate by publishing and/or disseminate by patenting will be taken by the management committee. We will target *Open Access* publications whenever possible. It can be achieved via Open Access Journals or alternatively via parallel publication by the researchers (self-archiving), often used by the universities.
b) The SEQUENCE project will align with efforts within the EU Quantum Flagship to run a **winter/summer school** during the course of the project, with contributions from all project partners. It will also open for external participants providing a path for networking with other consortia. The objective of the school is to provide a platform to educate European researchers on the state of the art in cryogenic electronics including its limitations and development. Lectures developed for the winter school will be reused by the academic partners, and integrated into postgraduate courses at their Institutes. The presentations will be open to the public on the SEQUENCE webpage.
c) The SEQUENCE consortium will **establish links** with other public funded European, US or Asian (Japan or Korea) consortia. The consortium intends to arrange an **International Workshop** on cryogenic electronics. SEQUENCE has established a connection to KAIST, South Korea, with efforts in III-V technology and 3D integration, and will pursue an exchange of research visits.
d) Contributions to the **IRDS roadmaps** to define the processes and performance of lateral and vertical III-V nanowire transistors for future technology nodes. ULUND and IBM are already contributing to IRDS and an important role of the SEQUENCE project will be to provide state-of-the-art data and play a leading role in defining the opportunities and challenges for III-V nanowire devices.

Updated Plans for External Communication

Based on discussions of the full SEQUENCE consortium at the Kick Off Meeting (Lund, January, 2020), an update to the external communication have been proposed. This update has been introduced to maximise the impact of communicating the project aims and achievements to Industry. The changes are also to allow the consortium members to be more proactive and flexible when interacting with industry. The proposed update is below.

The Kick-off meeting was held before the major Covid-19 outbreak and therefore the discussions could of course not foresee the impact a pandemic would have on the possibilities for external communication and interaction. The major travel restrictions has severely affects the external communication activities and it was therefore decided to intentionally delay this deliverable until we had a more clear picture of what to expect from the future. Since vaccinations are now in progress, we hope that travel restrictions will be less strict sometime in 2021. Therefore it is timely to submit the external communication plan.

Dissemination to Industry: Update

In the proposal it was mentioned that

*"To interact within an **international network**, the SEQUENCE partners have identified two main contact points, **RIKEN Institute in Tokyo, Japan**, and **KAIST University in Daejeon, South Korea**. Several of the SQUENCE partners have established connections that we will use for researcher exchange, speaker invitations to workshops, and visits with presentations as part of the Industrial Roadshow with the potential to establish deeper collaborations. These channels will provide dissemination to key areas in Asia, and simultaneously provide feed-back to Europe about research directions"*

Even though researcher exchange, speaker invitations and visits have not been possible in 2020 we are now optimistic that such activities can be resumed by the end of 2021 and we propose to then initiate the industrial roadshow as soon as possible. During spring of 2021 we plan to collect a dedicated slide-deck representing the effort of the full consortium that will be used as a basis for interaction with academic contact points as well as interested industry.

The mechanism for the networking with Industrial Stakeholders has been defined in more detail and the interaction was redefined. This will involve the development of the Industrial Roadshow, that is, dedicated visits from senior members of the SEQUENCE project to the Industries mentioned in the proposal (ST Microelectronics, Global Foundries, INFINEON, UMS, RUAG, THALES, Ericsson, ATOS, ID QUANTIQUE and others), to provide details of the aims and achievements of the project (effectively and Industrial Roadshow). These industry presentations will be based on an agreed slide deck, which will be updated at each SEQUENCE consortium meeting. Invitations to Industry advisory board member to meeting will still proceed as planned, but it often difficult for Industry partner to dedicate time to travel to meeting, and the consortium believe that this proactive approach of visiting relevant industry partners will be a more effective way to increase industry awareness of the EU funded project, as well as obtaining feedback from Industry. The relevant industry to visit will be reviewed at each SEQUENCE consortium meeting.

Current Progress on the External Communication Plan

Publications

A list of scientific peer review publications relating to the foreground of SEQUENCE project is kept in a live document continuously updated in the SEQUENCE back-office. These are also listed on the website.

Interactions between funded EU projects in the III-V devices area

In spite of the travel restrictions, some interaction with other EU funded projects in the area of III-V/quantum devices, such as *QuCube* has been enabled through the organisation of a webinar on Quantum Technologies (2020-06-23) with two speakers: Andreas Fuhrer (IBM) “From Transistors to Qubits” and Maud Vinet (CEA-LETI) “Quantum computing architectures challenges and consequences for low T electronics”.

The SEQUENCE website

The SEQUENCE website has been created and published at www.SEQUENCE-h2020.eu (more information can be found in D5.1). This allows outreach to the general public and therefore is mainly an external communication tool. However, due to the relevance to information gathering and back-office portal function it is also relevant to internal communication.

During the course of the project the website is continuously updated with news, events as well as project results. The PC/PMs is responsible for maintaining and updating the website and will also upload official project publications. All partners contribute with content.

The SEQUENCE Press Release

A press release has been issued by the consortium, however due to the covid-19 situation occupying a large portion of media space it was decided to delay the press release somewhat until it could attract more visibility and attention. Below is the full english version. A shorter Swedish version on a more popular science level has also been distributed to Swedish media. The press release was picked up by Ny Teknik which is one of the largest magazine on engineering and science for the general public in Sweden. They published a piece with an interview with Lars-Erik Wernersson (PC) available at https://www.nyteknik.se/innovation/sa-ska-lund-bana-vag-for-snabbare-kvantdatorer-6998986.

SEQUENCE is an innovative European research project that uses unconventional approaches to develop electronics for low temperature operation. This will enable quantum computers to scale up to be able to tackle a variety of important technological and scientific problems as well as improve satellite and terrestrial communication systems.

Electronics cooled to low temperatures will have a strong impact on our society through applications spanning space communication, high performance computing, and quantum enhanced computing. Quantum computers, for instance, have the potential to radically advance our computational capability and are predicted to strongly influence fields such as medicine, chemistry, science and finance by solving computational problems that cannot readily be solved by classical computers.

There are several promising technologies to realize quantum bits (qubits), which are the fundamental building blocks for quantum computers. Most of these, such as superconducting qubits, spin qubits and Majorana fermions, typically require very low (cryogenic) temperatures below -270°C to operate. A variety of bias, readout and control electronics for the qubits is required to perform computations. Presently, this is done using bulky equipment requiring a large set of long cables to be connected to the cooled qubits. Since the number of qubits needs to be scaled up significantly for quantum computing to become widely applicable, it is clear that a better solution needs to be developed where the electronics is cooled and placed in close vicinity of the qubits. Thus, there is a need for the development of electronic devices and circuits with a variety of functionalities. These need to be compatible with low temperature operation and have low noise and negligible heating to avoid disturbing the sensitive qubits. Achieving this will require enhanced understanding of the limitations of existing transistor technologies currently used for room temperature operation, development of 3D integrated systems and utilization of unique low-temperature effects in novel nanoelectronic devices.

In the European project SEQUENCE (Sense and Readout Electronics Cryogenically Integrated for QUantum ENhanced Computation and Evolving Communication) nine partners including universities, research institutes and industry from all over Europe are collaborating to tackle these challenges. The project will provide a versatile electronic platform by combining Si CMOS, III-V and 3D integration technologies to support the scaling of both superconducting and spin qubit based quantum computers. The challenges associated with operation at cryogenic temperatures will be addressed using innovative approaches to device design and fabrication that even turn the low temperatures into an advantage. Due to strong synergies, this electronic platform will not only enable quantum computers with improved scalability, performance and reduced cost, but will also have an impact on other important application areas such as space and terrestrial communication, radar technologies and high-performance computing.

The project will develop a variety of RF circuits such as low noise amplifiers, mixers, oscillators, digital-to-analog converters, multiplexers and RF switches that operate at extremely low power levels and also utilize the benefits of the low ambient temperature to achieve high performance.

"The development and integration of high speed electronics for low temperature operation is critical for the scaling of quantum computers that will enable the next step in the quantum revolution and will in addition improve future communication systems for a more connected world", says Lars-Erik Wernersson, professor at Lund University and project coordinator.

The SEQUENCE consortium consists of partners with a wide range of experience and expertise within material science, devices, circuits and systems. The partners are Lund University (Sweden), Fraunhofer IAF (Germany), Institute Polytechnique de Grenoble (France), IBM (Switzerland), CEA-LETI (France), University of Glasgow (UK), the Tyndall National Institute (Ireland), C2Amps (Sweden) and Ecole polytechnique fédérale de Lausanne (Switzerland). SEQUENCE is funded by the European Union H2020 Programme for Research and Development of the European Union (Grant – 871764)