ENCQOR 5G Technology Development Challenge Template

Feasibility of Si-based Quantum Information Processing

Challenge Launch Date	• October 7, 2019
Challenge Deadline	• November 4, 2019
Challenge Statement	Quantum computation will fundamentally change the way information is transmitted and processed in the next decade. This will transformation is expected to impact the telecommunication industry in the future. An area of strategic importance for the telecom sector is how to maintain secure communication when a quantum computer has the potential to break many cryptography systems. The telecommunications sector could use of quantum computers for many applications in the future including quantum cryptography, network optimization, quantum networking in terrestrial fiber networks, and AI applications. While there are many approaches to implement qubits, the basic building blocks of quantum computers, Ciena is interested in investigating the viability of using Si technology, which has been the preferred hardware platform for telecommunication systems. This academic research challenge is expected to demonstrate, experimentally, the potential for Si based qubit with the required high-speed circuitry and the possibility for operating above 4K and later at even higher temperatures. This activity will allow Ciena to closely follow the progress of this new information transmission and processing method and to have an informed opinion about the availability and characteristics of quantum information processing systems.
Project Partner	• Ciena Canada
Timeline	• 2 years
Available funding	• Up to $150,000 CDN
Applicant Type	• Ontario based College/University
Location	• Work can be completed remotely at the applicant institution
Project Details	• Identify promising device structures for the implementation of Si-based qubits and associated support circuitry. • Design and submit these structures to Ciena on regular Multi Project Wafer. • Experimentally verify the operation of these structures at low temperatures. • Evaluate the feasibility of creating several qubits and support circuits for operation at temperature of t 4K or higher.

Project Goals/ Outcomes	• By the end of this period there should be a theoretical and experimental demonstration of the feasibility of Si based qubits. • The successful application will be expected to summarise their findings in a report and compare to other published alternative approaches. •
Applicant Capabilities	• The applicant should have familiarity with the fundamentals of quantum computing and physical implementation of qubits • Knowledge of advanced Complementary Metal Oxide Semiconductor technologies • Experience with low temperature measurement • Background in mm wave circuit design and characterization
Additional Information	The following are samples of background research in the area of interest from the large amount of published information: • Silicon-based Quantum Computation, B.E. Kane, Laboratory for Physical Sciences, University of Maryland • A silicon-based nuclear spin quantum computer, B.E. Kane Semiconductor Nanofabrication Facility, University of New South Wales • A single-atom electron spin qubit in silicon, Jarryd J. Pla, Kuan Y. Tan, Juan P. Dehollain, Wee H. Lim, John J. L. Morton, David N. Jamieson, Andrew S. Dzurak & Andrea Morello, Nature 2012 • Gate-induced quantum-confinement transition of a single dopant atom in a silicon FinFET, G. P. LANSBERGEN, R. RAHMAN, C. J. WELLARD, I. WOO, J. CARO, N. COLLAERT, S. BIESEMANS, G. KLIMECK, L. C. L. HOLLENBERG3 AND S. ROGGE, Kavli Institute of Nanoscience, Delft University of Technology • Practical design and simulation of silicon-based quantum-dot qubits, Mark Friesen, Paul Rugheimer, Donald E. Savage, Max G. Lagally, Daniel W. van der Weide, Robert Joynt, and Mark A. Eriksson, Department of Physics, University of Wisconsin, PHYSICAL REVIEW B 2003 • https://www.zdnet.com/article/silicon-quantum-computing-launched-to-commercialise-unsw-quantum-work/ • https://newsroom.unsw.edu.au/news/science-tech/complete-design-silicon-quantum-computer-chip-unveiled • https://en.wikipedia.org/wiki/List_of_companies_involved_in_quantum_computing_or_communication

Launched in 2018, the ENCQOR 5G Academic Technology Development Program partners Ontario based Researchers with ENCQOR 5G Anchor Firms on 5G technology development projects. Areas of research interest are defined by Challenge Statements submitted to OCE by the ENCQOR 5G Anchor Firms and posted to the OCE website on a rolling basis.

If you are interested in developing an expression of interest, please visit the program guidelines for information on next steps.

For any questions about new Challenge Statements or the ENCQOR 5G Academic Technology Development Program please contact Jennifer Moles at Jennifer.Moles@oce-ontario.org.