5G (ENCQOR) Technology Development Challenge: Spectrum Sharing and Massive MIMO

Challenge Launch Date	February 26, 2019
Challenge Deadline	March 26, 2019
Challenge Statement	Spectrum sharing and massive MIMO antenna systems are two contemporary approaches to maximize the use of the spatial, temporal and frequency resources in wireless communication. In combination with network densification, achieving capacities offered by massive MIMO systems requires robust design approaches to avoid self-created drawbacks such as interference variations, dynamic outage situations, and under-utilization of shared resources. In addition, the spatial and temporal variations in data traffic require intelligent methods to learn the user and network behaviour. Of key interest is the development of cross layer and agile massive MIMO solutions operating at the edge of the network and capable of efficiently utilizing the resources shared among a large number of users and devices. Compatibility with 3GPP 5G NR and Wireless Innovation Forum specifications shall be taken into consideration.
Project Partner	Ericsson Canada Inc.
Timeline	1 year
Available funding	$100 000.00
Applicant Type	Ontario based College/University
Location	Ottawa is the main hub, though the research and development can be performed remotely. For a potential test-bed integration, at least a 6-month of presence of one or more project members may be required.
Project Details	Spectrum sharing and massive MIMO systems are already in product development by industry. In the US, the FCC has already allocated the 3.55-3.7 GHz band as the Citizen Broadband Radio Service (CBRS) band open for 3-tier spectrum sharing. In Canada, ISED is also considering flexible use of spectrum in possible targeted bands. Use of 5G technologies in the 3.5 GHz and other possible shared bands constitutes a significant market opportunity in not only North America but also globally. Edge computing and edge intelligence are evolving concepts that will enable realization of many 5G and beyond wireless technology applications. While these concepts are mainly focused on the upper layer processing of traffic data, a counterpart concept can readily be developed for the lower layers of the communication protocols including the PHY, MAC and RRC layers. In order to achieve targeted 5G wireless broadband capacities and ultra-low latencies, use of enabling technologies such as (1)

	massive MIMO systems, (2) efficient sharing of the wireless spectrum, and (3) ultra-dense networking are being investigated. The processing in the lower layer protocols needs to consider spatio-temporal variations in data flow to efficiently determine proper MIMO processing and spectrum usage. Furthermore, the proposed solutions are expected to be tested on a system level simulation platform that can model 5G use-case and deployment scenarios. The proposed techniques are expected to comply with message exchanging and signal processing methods in 3GPP 5G RAN specifications and Wireless Innovation Forum (US) specifications on spectrum sharing. Specifically, the proposed solutions should provide a) Algorithms that can learn the user and data traffic behaviour and adapt the massive MIMO system to maximize spectral efficiency such that the processing time lies within the latency requirements of the target application. -b) Adaptations of proposed solutions to existing industry standards enabling dynamic spectrum sharing and massive MIMO antenna systems It is expected that the project will enable the generation of innovative algorithms that can jointly learn and adapt the underlying MIMO system to changing wireless and traffic conditions and can make predictive and dynamic scheduling decisions that can maximize not only system performance and resource utilization but also avoid creating interference to links with high priorities.
Project Goals/ Outcomes	- Step-by-step detailed algorithms describing the learning mechanisms and corresponding MIMO signal processing/frequency allocation techniques. - Performance analysis and optimization of the proposed solution on a system-level simulation platform. - A 5G RAN solution employing massive MIMO with the capability of managing two or more shared spectrum chunks with proper directional transmissions and can avoid disrupting third party communications in the neighborhood. Ericsson Canada, Inc. will have the sole ownership of any IP generated by this collaboration and all other parties will be provided with the license rights. Individual trade and/or management of these IPs under a patent pool is governed by Ericsson Canada, Inc.
Applicant Capabilities	The lead applicant and the supporting research team will have extensive research expertise in areas closely related to the proposed project, including in system-level analysis and simulation of large heterogenous cellular networks, experience in embedded development of algorithms and

	in the use of machine learning techniques for wireless systems (with emphasis on MIMO and scheduling)
Additional Information	The main metrics to be improved by this challenge are network capacity and latency. Efficient utilization of frequency resources, and spatial distribution of network performance are also recommended as targets to improve. Simulator platform and test-bed integration with a scope limited to developed solutions may be available.