Ministry of Science and ICT

IITP Institute of Information & Communications Technology Planning & Evaluation

# APPLICATION FORM
# (JOINT RESEARCH)
## HIGH POTENTIAL INDIVIDUALS GLOBAL TRAINING PROGRAM)

### AGREEMENT

As stated above, I submit this application form to IITP that conducts "High Potential Individuals Global Training Program" supported by Ministry of Science, ICT in South Korea. IITP may disclose the information below to the public for the purpose of providing information and matching a research partnership between your institute and a Korean university.

* IITP : Institute for Information & communications Technology Planning & Evaluation

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| Printed Name of Chief of Research | Alagan Anpalagan | Date(mm-dd-yyyy) | 01-31-2020 |
| Signature of Chief of Research |  | | |

☞ ***(Note)*** *This application is to identify the willingness to participate in this research and to find a research partnership for research institutes in Korea. Therefore, in its sole discretion, it is acceptable to contain only minimal information. (max. 3 pages)*

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| **1. Research Title** | Autonomous Data-Driven Multi-RAT Radio Resource Management for 5G Systems | | | | | | |
| **2. Research Area** | **A.I.** | **Big Data** | **Cloud Computing** | **Block Chain** | **AR/ VR** | **ICT/SW Convergence** | **Other ICT /SW** |
| | **X** | | | | | **X** | |
| **3. Chief of research** | Title | Professor | | Contact | E-mail : alagan@ee.ryerson.ca | | |
| | Name | Alagan Anpalagan | | | Tel : +1-416 979-5000 x6079 | | |
| **4. Affiliation** | Name | Ryerson University, Canada | | Classification | (X) University ( ) Research Institute<br>( ) Industry ( ) ETC. | | |
| **5. Capacity for students (5 or less)** | 2 | | **Support for students** ***(all necessary)*** | | ( X ) Visa support<br>( X ) Research Mentoring<br>( X ) Research Space<br>( X ) Accessibility to Research equipment | | |

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| **6. Research Objective** | We are interested in applying Bayesian deep learning or/and reinforcement or/and unsupervised learning) or/and appropriate data-driven AI techniques that can be implemented in edge computing of the 5G networks for<br><br>(1) Multi-RAT dual connectivity management, including link selection and carrier aggregation management that accounts for user QoS requirements and minimizes latency, and<br>(2) Dynamic joint configuration of LTE-NR physical channels to control the spectrum sharing for each of the control channels, data channels and reference signals, as well as the amount of spectrum allocated for each of uplink and downlink traffic.<br><br>The applicant is proposing two research themes suitable for Master's and/or Doctoral students in the ICT (wireless communications and edge computing) / AI (data-driven, machine learning, optimization) areas. In details,<br><br>• **5G Multi-RAT Dual Connectivity Management:**<br>  • Developing learning based algorithm or any suitable data-driven AI technique, that select the LTE/NR links and determine the amount and type of user traffic that is sent on each leg, and for each carrier in multi-carrier setups.<br>  • The solution should consider and adapt to various factors such as the user QoS requirements, network load and latencies, radio conditions, and user distribution.<br>  • The devised techniques should be able to achieve different network defined objectives such as minimizing the total latency for end users or maximizing network throughput.<br><br>• **Dynamic Joint Configuration of LTE-NR Physical Channels:**<br>  • Develop a learning algorithm or any suitable data-driven AI technique, to calculate the optimal configuration of the NR frame including the resources, periodicity and density of the control channels, data channels and the reference signals used for channel estimation (e.g. CSIRS). This is in addition to configure the amount of spectrum allocated for uplink and downlink traffic.<br>  • The technique has to take into consideration a predefined level of channel estimation accuracy and a maximum tolerable level of throughput degradation under LTE-NR dual connectivity.<br>  • The algorithm extends to consider user-specific optimal configurations which meet a target user QoS level in different deployment scenarios (e.g. FDD and TDD systems).<br>  • The algorithm shall be applicable to large scale 5G network experiencing intercell interference, and other network dynamics due to user mobility and traffic variations. |

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| **7. Research Summary** | Massive amounts of data are anticipated to be pipelined over 5G networks to serve smart cities, connected autonomous cars, and IoT applications. The complexity of radio resource management (RRM) in 5G networks will however be unprecedented due to the highly configurable signalling, and the dense heterogeneous architectures spanning multiple radio bands. The challenge is to develop autonomous data-driven RRM techniques that maximize the capabilities of 5G networks, adapt to the continually changing environment, and enable various applications and services. Due to interdependency between the different RRM parameters, and the time varying channel conditions, a new optimization paradigm driven by the vast dataset, is required which exploits machine learning and artificial intelligence. In particular, we are interested in applying Baysian deep learning, reinforcement or unsupervised learning (or suitable data-driven AI techniques) at edges for multi-RAT dual connectivity management and dynamic joint configuration of LTE-NR physical channels for 5G and beyond 5G systems. |
| **8. Need for funding from Korean government** | The applicant (www.anpalagan.org) directs a research group working on 5G+ wireless systems and will supervise 1-2 graduate students on this project. Hence, he requests funding from Korean government to support the visiting Master's or Doctoral students. |
| **9. Request for Korean Universities** | The applicant is willing to collaborate with the academic researchers through the graduate student co-supervisions and joint publications. The applicant is happy to work with Korean counterparts in the selection of students and to discuss the modalities for effective training of individual students. Highly effective graduate student training, joint research activities and high quality publication are expected through this program. |