2018-00318 - [Campagne Doctorant 2018/CRI LILLE] - PhD
Thesis : Communication Protocols based on alternative
paradigm for wireless mobile devices (M/F)

Contract type : Public service fixed-term contract
Level of qualifications required : Graduate degree or equivalent
Fonction : PhD Position

About the research centre or Inria department

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The Inria Lille - Nord Europe Research Centre was founded in 2008 and employs a staff of 360,
including 300 scientists working in sixteen research teams. Recognised for its outstanding
contribution the socio-economic development of the Nord - Pas-de-Calais Region, the Inria Lille -
Nord Europe Research Centre undertakes research in the field of computer science in collaboration
with a range of academic, institutional and industrial partners.

The strategy of the Centre is to develop an internationally renowned centre of excellence with a
significant impact on the City of Lille and its surrounding area. It works to achieve this by pursuing a
range of ambitious research projects in such fields of computer science as the intelligence of data
and adaptive software systems. Building on the synergies between research and industry, Inria is a
major contributor to skills and technology transfer in the field of computer science.

Context

Job environments :

The INRIA FUN research group investigates solutions to enhance programmability, adaptability and
reachability of FUN (Future Ubiquitous Networks) composed of RFID, wireless sensor and robot
networks. Limited resources, high mobility and high security level evolving in distrust
environments characterize the objects that compose FUN. They communicate in a wireless way. To be
operational and efficient, such networks have to follow some self-organizing rules. Indeed, components of FUN have to be able in a distributed and energy-efficient way to discover the network, self-deploy, communicate, self-structure in spite of their hardware constraints while adapting the environment in which they evolve. For additional information on the FUN research group, please see http://team.inria.fr/fun/

Assignment

Assignments :

Under the direct responsibility of the supervisor, the candidate will be in charge to investigate
alternative communication paradigms and develop a new communication protocol based on one of
the selected paradigms for wireless mobile devices. Moreover, the candidate will be in charge to analyze and design coexistence solutions with preexisting communication techniques (e.g. WiFi, Bluetooth, etc.). The candidate will validate theoretical solutions through simulation and a proof-of-concept approach based on implementation on real devices.

For a better knowledge of the proposed research subject : Cooperation and coexistence of heterogeneous technologies and devices play a key role to realize ubiquitous and pervasive networks. Generally, the cooperation among heterogeneous devices is based on information acquired through the communication among the nodes. "Traditional" communication paradigms are based on link through electromagnetic fields waves (i.e. electromagnetic radiation), but alternative communication paradigms can be envisaged to improve efficiency, energy consumption and ubiquitous concept. For example, one can think to exploit the already available (to illuminate) LEDs that could be conveniently used to acquire useful information based on different emerging communication paradigm such as the VLC [1].

A different communication paradigm could have inherent advantages in respect of the traditional approach such as:

1) An environment where a “traditional” communication paradigm is difficult (e.g. environments too noisy with too many interferences);

2) Data rate could be higher than traditional communication (e.g. as in the case of the VLC paradigm);

3) The possibility to design and implement “smart” devices, that could adaptively select the best way to communicate based on their proper current status, the status of the neighbors and the surrounding conditions.
The objective of this PhD course is to study and derive alternative communication paradigms among mobile devices. At the beginning, the PhD student will review the literature, by focusing on different and alternative (in respect of traditional techniques), such as computer vision techniques. The candidate will be supported in the definition of the requirements of the system as system supporting a new communication paradigm and can exploit the background and expertise of the team in this context acquired in the last years and that dealt to the implementation of two test-beds.

The first one is concerning a VLC communication system where an Artificial Intelligence (AI) approach has been developed on top of the receiver (a photodiode) in order to manage control parameters to reduce the Bit Error Ratio (BER) [2].

The other test-bed is implementing an indoor geo-localization system with a mobile user (i.e. the transmitter) that has to be geo-localized.

The final part of the doctoral program will be devoted to the design and implementation of a communication protocol based on a specific novel communication paradigm. The PhD candidate will be asked to analyze and identify some specific evaluation parameters, in order to define the goodness of the protocol.

Moreover, the candidate will be asked to investigate and study the learning techniques, in order to develop effective and efficient cooperation mechanisms among the nodes.


Project Team Link: http://team.inria.fr/fun/

For more details on VLC publications: http://researchers.lille.inria.fr/~loscri/publications.html

Main activities

1) Acquisition of theoretical background and knowledge to design communication techniques based on a different communication paradigm;

2) Design of cooperation techniques based on a new communication paradigms and capacity to identify the criticism of the communication system;

3) Revision of Artificial Intelligence techniques and identification of a suitable AI approach to be applied to the communication system in order to improve the communication performance of the system (e.g. its capability to react to the interference);

4) Identification of target scenarios for testing the developed techniques;

5) Validation of the proposed solutions.

Skills

Technical skills and level required:

- Very good programming skills in C/C++/Python, Experience using Linux systems
- Ability to implement code on real devices
- The willingness to contribute to interdisciplinary scientific project
- Strong mathematical and physical background

Languages:

- English

Relational skills:

- The willingness to contribute to interdisciplinary scientific project
- Sense of organization, autonomy, rigor
- Teamwork taste
- Listening and communicating with non-technical contacts;

Other valued appreciated:

- Know write notes / reports

Benefits package
Benefits

- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave
- Sports facilities
- Flexible working hours

More information about Lille:
http://www.lille3000.eu/portail/
http://www.lillemetropole.fr/mel.html

Remuneration

Remunerating:

The gross monthly salary is 1982€ for the 1st and the 2nd year, 2085€ for the 3rd year.