



Offer #2023-06187

PhD Position F/M Trust-based approaches in multi-technology Industrial Internet of Things (M/F)

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

About the research centre or Inria department

The Inria University of Lille centre, created in 2008, employs 360 people including 305 scientists in 15 research teams. Recognised for its strong involvement in the socio-economic development of the Hauts-De-France region, the Inria University of Lille centre pursues a close relationship with large companies and SMEs. By promoting synergies between researchers and industrialists, Inria participates in the transfer of skills and expertise in digital technologies and provides access to the best European and international research for the benefit of innovation and companies, particularly in the region.

For more than 10 years, the Inria University of Lille centre has been located at the heart of Lille's university and scientific ecosystem, as well as at the heart of Frenchtech, with a technology showroom based on Avenue de Bretagne in Lille, on the EuraTechnologies site of economic excellence dedicated to information and communication technologies (ICT).

Context

The PhD student will be co-supervised by Valeria Loscri (FUN Team) and Abderrahim Benslimane (University of Avignon).

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, and high mobility evolving in distrusted 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 adapting the environment in which they evolve. For additional information on the FUN research group, please see <http://team.inria.fr/fun/>

A PhD position is available within the Inria FUN. The position is for three years.

Assignment

The industrial revolution 4.0 will be strongly based on the IIoT paradigm, in order to automate the automobile manufactures plants with high connected architectures. In this specific context, the security is strictly related to trust management models, as demonstrated in some recent works [1]. Trust concept is subject to different definitions, based on the specific context and applications, and no standard for IoT or IIoT are defined to make this concept uniquely defined. Anyway, since traditional security solutions, based on encryption are not suitable for resource-constrained devices, trust seems a viable solution for ensuring high security level in contexts as the automotive factory, where the sensitivity of data is very high. In some recent works this concept has been well demonstrated [2], where a hierarchical architecture to effectively manage the trustiness in IIoT has been demonstrated. Anyway, the underlying wireless communication, is completely neglected, and the wireless communication technology are not considered. In this thesis, the idea is to focus on different wireless communication technologies, encompassing traditional IEEE 802.15.4 solutions usually considered in IIoT context, and integrating Optical Wireless Communication, that combined with a hierarchical architecture as defined in [2], can improve the security of the IIoT systems, while lowering the inherent overhead, due to a better management of the clusters in the hierarchical architecture. The system will be more robust to attacks such as Distributed Denial of Services (DDoS), e.g., jamming attacks, or adversarial attacks, that can modify the outcome of specific machine learning considered to manage in an automatic way the different architecture layers [3, 4, 5].

The primary objective is to integrate the diversity of features of wireless communication technology in IIoT, in order to design new trust management models, guaranteeing high level of security with low overhead and very low latency.

Expected outcomes

The specific outcome, will be a whole hierarchical architecture, managing in an effective, energy-aware way trust model between resource-constrained and heterogeneous nodes. The overall system, will be not only capable to manage the automobile manufacturers plants in an automated way, but will also be robust in respect of untrusted nodes and physical layer attacks. The solutions developed in this context, will be generally applicable in different Internet of everything (IoE) contexts and more largely to trust/security management of real-time 6G networks.

[1] Chaimaa Boudagdigue, Abderrahim Benslimane, Abdellatif Kobbane, and Jiajia Liu, "Trust Management in Industrial Internet of Things" In IEEE Transactions on Information Forensics and Security, vol. 15, (2020), pp. 3667-3682, DOI: 10.1109/TIFS.2020.2997179

[2] Chaimaa Boudagdigue, Abderrahim Benslimane, Abdellatif Kobbane, and Jiajia Liu, "Trust-based Certificate Management for industrial IoT Networks" In IEEE Internet of Things Journal, (2023).

[3] Emilie Bout, Valentin Bout, Alessandro Brighente, Mauro Conti, Valeria Loscri. Evaluation of Channel Hopping Strategies Against Smart Jamming Attacks. IEEE ICC 2023 - IEEE International Conference on Communications, IEEE, May 2023, Rome, Italy.

[4] E. Bout, V. Loscri and A. Gallais, "HARPAGON: An Energy Management Framework for Attacks in IoT Networks," in IEEE Internet of Things Journal, vol. 9, no. 20, pp. 19959-19970, 15 Oct.15, 2022, doi: 10.1109/JIOT.2022.3172849.

[5] E. Bout, V. Loscri and A. Gallais, "How Machine Learning Changes the Nature of Cyberattacks on IoT Networks: A Survey," in IEEE Communications Surveys & Tutorials, vol. 24, no. 1, pp. 248-279, Firstquarter 2022, doi: 10.1109/COMST.2021.3127267.

Main activities

Main activities :

- Study of the State of Art of trust model in IoT and IIoT
- Design of multi-technology approaches in IoT and IIoT architectures
- Integration of trust-based schemes in multi-technology solutions
- Validation of the solutions via simulation and experiments

Additional activities :

- Writing reports
- Participation to the deliverables writing

Skills

Technical skills and level required : Programming skills on C++, Python and Matlab

Languages : English or French

Relational skills :Capacity to work in team

Benefits package

You will integrate a dynamic team of international scientific experts in the field of IoT (<http://team.inria.fr/fun/>)

You will work on emerging research activities with recognized international IoT and cybersecurity actors.

You will work in a stimulating and pleasant work environment (transport participation (50%), on-site catering, teleworking, leave and special leave of absence (45 days), video conference equipment, technical laboratory for experimentation ...)

You can benefit from quality training adapted to your needs and skills, whether technical, methodological or linguistic.

In addition to improving your technical skills, Inria offers you the opportunity to develop your entrepreneurial skills by participating in awareness-raising events and training courses on the creation of start-ups (start-up horizon, intellectual property training, hackAtheq, etc.).
<https://www.inria.fr/fr/inria-startup-studio>

For international candidates, our administrative services will help you with the various administrative procedures (visa, residence permit, social security, housing, bank, etc.)

Remuneration

1st and 2nd year : 2051 € Gross monthly salary (before taxes)

3rd year : 2158 € gross monthly salary (before taxes)

General Information

- **Theme/Domain** : Networks and Telecommunications System & Networks (BAP E)
- **Town/city** : Villeneuve d'Ascq
- **Inria Center** : [Centre Inria de l'Université de Lille](#)
- **Starting date** : 2023-10-01
- **Duration of contract** : 3 years
- **Deadline to apply** : 2023-06-26

Contacts

- **Inria Team** : [FUN](#)
- **PhD Supervisor** :
Loscri Valeria / Valeria.Loscri@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

The keys to success

- Good knowledge of wireless networks and communication paradigms
- Knowledge of basics of data modelling

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

CV + application letter + recommendation letter(s)

Defence Security :

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :

As part of its diversity policy, all Inria positions are accessible to people with disabilities.