Nano-Autonomous Systems for a Privacy Aware Internet of Things

Position	PhD scholarship, 2018 - 2021
Location	ICube Laboratory (UMR CNRS 7357), University of Strasbourg (France)
	Network Research Group
Supervisors	Dr. Antoine Gallais (Univ. Strasbourg)
	Dr. Fabrice Theoleyre (CNRS)
	Dr. Pascal Merindol (Univ. Strasbourg)
Salary	1,800€/month (gross)
Start date	between Nov. 2018 and March 2019 (negotiable)
Deadline	applications will be reviewed immediately until the position is filled
Contact	nanoas@icube.unistra.fr

Main Topics

- Privacy by design;

- Data aware routing policies;

- Internet of Things;

Context

In the last years has emerged the so-called Internet of Things (IoT) which consists in inter-connecting new (Smart) Objects via the hierarchical AS-graph of the Internet. Complex Human Cyber Physical Systems (HCPS) [1] now require sophisticated interactions between sensors, actuators and humans to take smart decisions while, today, sensors simply push their data to a cloud (located somewhere in the Internet). It is crucial to be able to carry out these operations as close as possible to the objects, in order to ease the emergence of new and efficient IoT applications. More and more computing and storage resources are available in the "neighborhood" of an object [2]. In addition, the delay induced by a "cloud" degrades the performance of real-time applications [3]. Finally, privacy has become a cornerstone of the Internet of Things, requiring the data to be processed as close as possible to the producer, in order to limit its dissemination.

Scientific Objectives

The group has proposed a network architecture relying on the concept of nano Autonomous Systems, to respect the privacy for the Internet of Things.

The PhD student will focus on the policy-based routing mechanisms to set-up a privacy aware Internet of Things. She/He will first propose novel algorithms to enable fast and efficient forwarding inside this architecture. The routing algorithms must balance efficiently the load, spatially and temporally to avoid congestion. A strong focus will be given on the system's stability since wireless networks exhibit very time-varying conditions.

Then, the PhD student will focus on the establishment of policy-based routing when exploiting this AS architecture. Some content centric rules have to be incorporated, while still guaranteeing the convergence of the system. Self-optimizing algorithms have to continuously assess the performance of the system to reconfigure the routes on the fly if required.

To prove the relevance of his propositions, the PhD student will also implement her/his algorithms on a testbed to evaluate in vivo their behavior. Most of the solutions are expected to be implemented on the FIT IoT-LAB platform. Simulations (Contiki OS / OpenWSN) and theoretical analyses can be also expected.

Information about the Department

The ICube lab (http://icube.unistra.fr) is a multidisciplinary research institute (University of Strasbourg / CNRS). With around 650 members, ICube is a major driving force for research in Strasbourg whose main areas of application are material engineering, scientific computing, and computer science. The State-funded Investissements d'Avenir's call for projects proved to be highly successful for the laboratory. ICube hosts 2 platforms of excellence (equipex), including the Robotex and FIT IoT-LAB testbeds.

The group is part of the network research team, in the computer science department. The partner has a strong experience in wireless and wired networks, from the model to the prototype. The members are particularly recognized for their research on the Internet of Things, with novel algorithms and protocols to create an efficient Internet for low power devices. They have already extensively collaborated with major industrial companies (e.g. Thales, ST, Orange Labs, Cisco, Technology & Strategy) through collaborative or bilateral projects.

Required qualifications

- A master's degree in Computer Science, Electrical and Computer Engineering, or related areas;

- Knowledge in networking (routing, BGP) distributed algorithms. Basic knowledge on recent NFV and SDN techniques would be a plus;

- Strong programming and organizational skills;

- High motivation for research work and ability to work independently;

- Eagerness to disseminate research results through publications and presentations at international conferences. Publication activities in the aforementioned disciplines will be considered an advantage;

- Availability to travel and good written and spoken communication skills in english. French is not a requirement, since our group hosts several nationalities (e.g. Algeria, Argentina, Brazil, Greece, Tunisia).

Conditions

We are offering:

- interesting and challenging research in a performance-orientated and family-friendly environment;

- modern research facilities, with a privileged access to the large-scale FIT IoT-LAB testbed;

- a 3 year contract (1,800€/month gross, without teaching duties which are worth considering);

- strong focus on international collaboration.

Application

PhD candidates have to submit to an application package containing:

- curriculum vitae and academic record;

- Certified copies of transcripts and diplomas;

- Names and contact information of at least 2 reference persons;

- Research statement (max. 2 pages) including:

    - A short presentation of the motivation for a PhD study,
    - The applicant's view of research challenges within the area of the PhD position,
    - The applicant should show how her/his abilities can contribute to solving these challenges.

The ICube laboratory and the University of Strasbourg provide an attractive environment to outstanding and creative candidates. We believe that diversity is important to achieve a good, inclusive working environment. Thus, we encourage all qualified candidates to apply.

References

[1] Taskin Padir, Kaushik Chowdhury, Deniz Erdogmus, and Gunar Schirner. The future of human-in-the-loop cyber-physical systems. IEEE Computer, 46:36–45, 2013.

[2] M. Chiang, S. Ha, C. L. I, F. Risso, and T. Zhang. Clarifying fog computing and networking: 10 questions and answers. IEEE Communications Magazine, 55(4):18–20, April 2017.

[3] C. Lu, A. Saifullah, B. Li, M. Sha, H. Gonzalez, D. Gunatilaka, C. Wu, L. Nie, and Y. Chen. Real-time wireless sensor-actuator networks for industrial cyber-physical systems. Proceedings of the IEEE, 104(5):1013–1024, May 2016.