

Distributed Adaptive Scheduling for Multichannel IoT Networks

Open Research Engineer/Postdoc position

Admin

- Type of position: Research Engineer or Postdoc (*see below*)
- Location: Inria-Paris, France
- Supervisor: Pascale Minet, PhD
pascale.minet@inria.fr
- Keywords: TSCH, Scheduling, 6TiSCH, OpenWSN
- Inria Team: EVA
<https://team.inria.fr/eva/>
- Overarching project: ADT DASMU
- Application deadline: The position is available immediately and needs to be filled quickly. Evaluation of applications will begin immediately and continue until the position is filled.
Candidates are encouraged to apply now.
- Expected start date: ideally 2 October 2017
- Duration: 24 months

Working at Inria

Established in 1967, Inria is the only public research body fully dedicated to computational science. Combining computer sciences with mathematics, Inria's 3,500 researchers strive to invent the digital technologies of the future. Educated at leading international universities, they creatively integrate basic research with applied research and dedicate themselves to solving real problems, collaborating with the main players in public and private research in France and abroad and transferring results innovative companies. Inria researchers have published over 4,500 articles in 2013 and are behind over 270 active patents and 110 start-up companies. In 2013, Inria's budget was 235 million euros, 25% of which represented its own resources. The 180 project teams are distributed in eight research centers located throughout France.

The brand new Inria-Paris research center is located in the heart of Paris. Thanks to its top-quality researchers and numerous international guests, the Inria-Paris research center plays a leading role in international research, with a strong focus on networking and communication systems. The 41 research teams of the center are continuously pushing the boundaries in developing new concepts and techniques.

In 2015, Glassdoor ranked Inria the #1 company in France for the wellbeing of its employees¹.

EVA (<https://team.inria.fr/eva/>) is a leading research team in low-power wireless communications. The research team, led by 3 faculty members (Pascale Minet, Paul Muhlethaler, Thomas Watteyne), is designing Tomorrow's Internet of (Important) Things. The team pushes the limits of low-power wireless mesh networking by applying them to critical applications such as industrial control loops, with harsh reliability, scalability, security and energy constraints. Grounded in real-world use cases and experimentation, EVA co-chairs the IETF 6TiSCH standardization working group and co-leads Berkeley's OpenWSN project. The team is associated with Prof. Glaser's (UC Berkeley) and Prof. Kerkez (U. Michigan) through the REALMS associate research team.

Description of the work

This position is part of the DASMU (Distributed Adaptive Scheduling for Multichannel Wireless Sensor Networks) project, funded directly by Inria. The project focuses on low-power wireless networks for critical applications, in which devices may produce a lot of data (possibly hundreds of samples per second) and which requires wire-like reliability. Application domains include industrial, urban, home, building and environmental.

Low-power wireless networks are constrained in nature, mainly in terms of available communication bandwidth and energy. Communication protocols have to take these constraints into account. Time Synchronized Channel Hopping (TSCH) is now widely regarded as the right technology for this type of application. In a TSCH network, nodes are synchronized and a schedule orchestrates all communication. Time synchronized yields ultra low-power operation; channel hopping yields wire-like reliability. It supports both upstream and downstream communication.

TSCH technology is being standardized by the IETF 6TiSCH working group (<https://tools.ietf.org/wg/6tisch/charters>). While the standardization activity is well underway, what is entirely missing is a distributed scheduling algorithm (a "Scheduling Function" – SF – in 6TiSCH parlance). Your primary job will be to design such an SF, implement it on the OpenWSN, evaluate it, and push it through the standardization process.

The goal of the distributed scheduling solution is to cope with heterogeneous traffic (amount of data produced by each device), traffic changes (different sampling rates), topological changes (routing structure updates, nodes being added/removed, etc.) and link quality changes. One of the main goals of the evaluation part of your solution is to identify the level of latency, reliability and power consumption it offers, and how that compares to different applications.

¹ <http://business.lesechos.fr/directions-ressources-humaines/02180452763-l-inria-l-entreprise-la-plus-soucieuse-de-ses-salaries-111361.php>

Specific tasks include:

- Get familiar with the OpenWSN (www.openwsn.org) open-source 6TiSCH implementation, and learn how to run a simulation and experiment. Inria-EVA is co-leading the OpenWSN project, so you'll find plenty of people to help you get started.
- Get familiar with the 6TiSCH simulator (<https://bitbucket.org/6tisch/simulator/>), which is Python-based. Inria-EVA co-leads this project, so you'll find plenty of people to help you get started.
- Design a distributed scheduling solution which schedules for each node enough slots to satisfy its application needs, ideally in a collision-free manner, while ensure wire-like reliability and ultra low-power operation.
- Evaluate the performance of your solution both in simulation and experimentally.

Skills and Expertise

We are looking for an advanced engineer or a postdoctoral researcher ready to make a significant contribution to the field of standards-based low-power wireless mesh networking IoT technology:

- The position is open to both Engineers (i.e. you have an Engineer and/or Masters degree) and Postdoctoral researchers (i.e. you have a PhD degree) in Computer Science, Telecommunications, Electrical Engineering or related field.
- We ask for min. 2 years of expertise in low-power wireless networks (mesh networks, WSNs, etc.)
- strong “hard” skills
 - very good programming skills and experience (C/Python/Java, etc.), including web development (server-side, JavaScript, PHP, html, etc.)
 - general understanding of software quality and project management tools (Git, GitHub, Travis-CI, Jenkins, etc)
 - some embedded programming experience (micro-controllers such as MSP430, Cortex-M) ideally involving low-power wireless devices
 - ideally, experience with IoT-related standards such as IEEE802.15.4, IEEE802.15.4e, IETF 6TiSCH, 6LoWPAN, RPL, CoAP, etc.
 - ideally, experience with IoT-related projects such as OpenWSN, RIOT, Contiki, TinyOS
 - ideally, experience with IoT-related testbeds such as FIT/IoT-lab
 - for postdocs, a strong publication track-record and proven expertise in the general topic of IoT
- strong “soft” skills
 - we are looking for the “technical leader” type. If you have participated in open-source projects, have lead a software development team, tell us about it!
 - ideally, some open-source project experience, including source code and project management tools (Git, GitHub, Travis-CI, etc)

Environment

You will work in an extremely stimulating environment, within the EVA team (<https://team.inria.fr/eva/>), but also in constant collaboration with other international research teams, through open-source projects, and by interacting with standardization bodies.

You will play an important role in the EVA team. You will be instrumental in architecting a distributed scheduling approach, and will lead the implementation work. You will be able to interact closely with the IETF standardization process, in particular in the 6TiSCH working group, co-chaired by Thomas Watteyne. This will give you an opportunity to experience the standardization process first-hand and contribute to defining tomorrow's standards and products.

If you are so inclined, you will have ample opportunity to conduct cutting-edge research (and publish!) around the project, IoT standards and low-power wireless technology, in one of the most vibrant research teams in the field.

Benefits

Located at the heart of Europe, Paris is a unique place to work and live in. Inria offers a unique balance between working in a leading research center and living in one of the most beautiful and bustling cities in the world. A real communication hub, Paris is a gateway to France and Western Europe, and working in the Inria-Paris research center is real asset to your career.

- Competitive salary
- Medical coverage
- approx. 45 days of annual vacation
- Inria covers part of your commute expenses (metro, bus, etc.)
- When needed, Inria will help you apply for Scientific Resident card and a visa
- on-site restaurant (Inria pays for part of you expenses)
- optional French classes (free)

How to apply

Send your CV and cover letter to pascale.minet@inria.fr with the subject “[ADT DASMU] application”. Don't hesitate to ask clarifying questions before applying.

Evaluation of applications will begin immediately and continue until the position is filled. **Candidates are encouraged to apply now.**

Note well

- Speaking French is *not* a requirement. Professional proficiency in English is, however, important.
- In the interests of protecting its scientific and technological assets, Inria is a restricted-access establishment. Consequently, it observes special regulations for welcoming foreign visitors from outside of the Schengen area. The final acceptance of each candidate thus depends on applying this security and defense procedure.