2018-00827 - Tools for micro IoT kernels (M/F)

Level of qualifications required : Graduate degree or equivalent
Other valued qualifications : Bac + 5

Assignment

Over the last years, the RMOD team of INRIA Lille and the CAR theme of IMT Lille Douai have been working together on creating tiny language core. For example, Guillaume Polito demonstrated in his PhD a fully reflective kernel that fits into 80 kb of memory and that it is possible to have hyper specialized kernels down to 11 kb. We have also worked on remote debugging (PhD of N. Papoulias) and dynamic code updates (PhD of P. Tsonou) of such kernels. All of these works are prototyped in Pharo. More recently, RMOD have been working on advanced probes mechanisms (M. Denker) and a solid remote debugging infrastructure (D. Krudivsakov).

The goal of this PhD is to revisit the architecture around such mini-kernels for building IoT applications. The following tasks are foreseen:

- improve the tools to : edit, compile, debug, deploy and update such kernels on IoT devices. Learning how to debug remotely and dynamically update such IoT systems using the PhamiD Pharo environment. This task will be in cooperation with M. Denker and D. Krudivsakov on remote debugging for IoT and G. Polito for the kernel edition and tooling,
- define some language extensions to manage groups of IoT devices to program them at once. Managing hundreds or even thousands of IoT devices is a challenging task. We want to explore different solutions to help deploying and updating groups of IoT devices using some registration mechanism in a cloud server or some groups/roles based approaches for example,
- expressing the architecture of IoT applications. We would like to explore also how to express IoT architectures and what are the abstractions that should be offered to developers such as expressing event-driven architectures with declarative ECA (Event-Conditions-Actions) rules. But we will study a couple of typical IoT applications.
- dynamically update an IoT application. An IoT application needs to adapt itself because unreachable or faulty devices or the diminution of available bandwidth. We would like that the whole application can reconfigure itself in such situations as Guillaume Grondin proposes it in its PhD.
- Lightweight virtual machines. Virtual machines in the IoT context are very powerful for incremental deployment or dynamic updates. Although they are tuned for speed, they consume space compared to a non VM-based program. In this task, we would like to investigate what is the minimal memory consumption that we can reach for a VM usable for IoT. To do so we will use a standard VM such as Cog (the open-source virtual machine of Pharo) and degrade it. We will use it since our minimal kernels are running on it.

Note that ZweiDenker GmbH is interested in collaboration on the IoT management cloud infrastructure.

- Extended results of Tornado : A Run-Fail-Grow approach for Dynamic Application Tayloring. Commanditeur : École des mines de Douai, France. 50p, July 2014

Main activities

- Article reading and writing
- Idea generation
- Design and validation of ideas and tools

Skills

Competences techniques et niveau requis :

- Pharo http://www.pharo.org
- C

Langues :

- french
- english

Benefits package

General Information

- Theme/Domain : Distributed programming and Software engineering
- Town/City : Villeneuve d’Ascq
- Inria Center : CRI Lille - Nord Europe
- Starting date : 2018-10-01
- Duration of contract : 3 years
- Deadline to apply : 2018-09-31

Contacts

- Inria Team : RMOD
- Recruiter : Stéphane Ducasse / stephane.ducasse@inria.fr

About Inria

Inria, the French National Institute for computer science and applied mathematics, promotes “scientific excellence for technology transfer and society”. Graduates from the world’s top universities, Inria’s 2,700 employees rise to the challenges of digital sciences. With its open, agile model, Inria is able to explore original approaches with its partners in industry and academia and provide an efficient response to the multidisciplinary and application challenges of the digital transformation. Inria is the source of many innovations that add value and create jobs.

Conditions for application

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.

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.

Contact

Inria Team : RMOD
Recruiter :
Stéphane Ducasse / stephane.ducasse@inria.fr
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