ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

TIK Institut für Technische Informatik und Kommunikationsnetze
Computer Engineering and Networks Laboratory

Prof. L. Thiele

Semester Thesis

Unleashing the potential of Real-time Internet of Things

Motivation Connected objects have become a part of our everyday life. Everything gets connected – not only our phone and our watch, but also our fridge, our clothes, even light bulbs! Together, they form the so-called Internet of Things (IoT).

Most of such objects have limited capabilities, *e.g.*, in terms of computation power or memory storage. Therefore, IoT networks usually run very basic functionality, resulting in limited efficiency and high vulnerability to malicious attacks (see [1] for a recent example).

A solution is to use the cloud to run advanced functionality, *e.g.*, real-time scheduling. However, it is nowadays *impossible to run real-time applications in the cloud*. In other words, if you send a request, there is no guarantee on the delay until you get a response. This is a major limitation for many applications, especially in safety critical cases, *e.g.*, in connected cars. *Edge-computing* is an alternative solution which proposes to distribute complex tasks having real-time requirements to high(er) capability devices sitting at the "edge" of the network, *i.e.*, closer to where the functionality are needed. In our group, we developed a heterogeneous dual-processor platform enabling edge-computing. One processor efficiently runs low-power networking protocols, fitted for IoT applications ; the other is dedicated to computationally heavy tasks. To enable real-time communication between the two processors, a predictable interface was designed: Bolt [2].

Task description In this project, the objective is to enable real-time wireless communication for the Internet of Things. You will provided with some software – a scheduling algorithm and a wireless communication protocol – some hardware – predictable dual-processor platforms based on Bolt – and a wireless network of 30-nodes connected to a testbed infrastructure. Your tasks consist in

- Porting the real-time scheduling algorithm to run on the dual-processor platform,
- Adapting the communication protocol to take into account the computation of the schedule at the edge of the network,
- Integrating this system into Flocklab [3], our wireless network testbed,
- Using this environment to implement, test, and evaluate a state-of-the-art real-time communication protocols for the Internet of Things [4].

Requirements You should be highly motivated, have experience in C programming for embedded systems, and be interested in real-world experiments. Basic knowledge in communication protocols is a plus.

References

[1] IEEE Spectrum What Is a Distributed Denial-of-Service Attack and How Did It Break Twitter?, Oct. 2016
[2] Bolt: A Stateful Processor Interconnect, F. Sutton, et al., SenSys 2015.
[3] Flocklab: www.flocklab.ethz.ch/
[4] End-to-end Real-time Guarantees in Wireless Cyber-physical Systems, R. Jacob et al., RTSS 2016.

Interested?
Contact me for more details!

Romain Jacob, ETZ G75
romain.jacob@tik.ee.ethz.ch