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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!**

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