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:

Fault-tolerance mechanisms for Glossy-based wireless communication networks

Motivation In recent year, significant advancement has been achieved in low-power wireless communication in multi-hop networks by using concurrent transmissions [1]. On the physical layer, two phenomena, constructive interference and the capture effect, enable to create highly reliable wireless communication primitives. For example, Glossy [2] is a flooding primitive that achieves packet reception rates above 99.99% in real-life tests. Flooding consists in having a sender broadcasting its message to all receivers in range, which in turns forward this message to all receivers in their range, and so on. Each packet is thus *flooded* to all the nodes in the network, one (or several) of which being the intended recipient(s).

Although reliability is very high, some problems may still occur: a packet is lost, a node suffers a power failure, a plane crashes on the building. Those are qualified as *faults*, *i.e.*, an unexpected deviation from the nominal behavior. Up-to-date, Glossy-based communication protocols have focused on increasing the nominal reliability, but do not take explicitly faults into accounts in the protocol design. Therefore, the goal of this thesis is to investigate fault-tolerance control strategies for a Glossy-based wireless communication networks.

Task description In this project, we start by considering the Low-power Wireless Bus [3], a MAC protocol based on Glossy floods. Your task consists in investigating the following questions

- Which kind of faults can occur in the network? In other words, which type of packets can be lost, where and when? What are the hypothesis we make here?
- What is the consequence of such faults occurring? How can they be detected?
- What actions can be taken to mitigate the effects of a fault? In other words, what is the control strategy?
- What guarantees can we obtain from such control strategy?

It has been shown that, using Glossy, packet losses occur with nice probabilistic properties [4]. Therefore, it should be fairly easy to provide clean probabilistic performance guarantees for a given control strategy. This would be very nice as (i) it is hard to do in general (ii) it is required in many industries working with critical systems, *e.g.*, avionics, automotive, etc..

Requirements: Interest in theoretical work and protocol design. Basic knowledge on wireless communication protocols is a plus.

References:

[1] Lets Talk Together: Understanding Concurrent Transmission in Wireless Sensor Networks, D. Yuan, M. Hollick, LCN 2013.
[2] Efficient Network Flooding and Time Synchronization with Glossy, F. Ferrari et al., IPSN 2011.
[3] Low-Power Wireless Bus, F. Ferrari et al., SenSys 2012.
[4] On Modeling Low-Power Wireless Protocols Based on Synchronous Packet Transmissions, M. Zimmerling et al., MASCOTS 2013.

Interested?
Contact me for more details!

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