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:

Low-Error Multi-Hop Clock Synchronization

Motivation: Maintaining precise time synchronization is essential in wireless sensor networks. However, clock sources often exhibit severe drift. Also message exchange is subject to delays due to varying distances between nodes, packet collisions, and multipath effects. Sophisticated time synchronization algorithms are necessary to keep nodes' clocks synchronized. Existing network-wide synchronization algorithms for sensor networks synchronize clocks hop-by-hop (see Fig. 1). This leads to a well-known problem of error accumulation over multiple hops and results in large synchronization errors at nodes with increasing distance from a reference time source.

State-of-the-art time synchronization protocols for wireless sensor networks (e.g., Flooding Time Synchronization Protocol (FTSP) and Rapid Time Synchronisation (RATS)) use ordinary least squares regression to estimate and compensate clock drifts. We have good arguments to believe that this standard regression approach is not appropriate in the context of time synchronization and suggest using a different regression approach. Our preliminary analysis shows that this will allow reducing multi-hop synchronization errors and achieve a significantly better global time synchronization in the network.

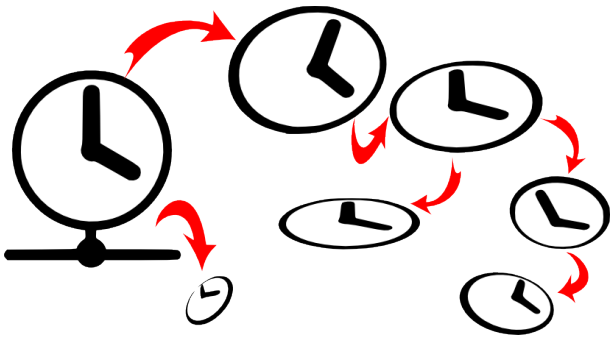

Figure 1: Multi-hop clock synchronization.

Task: The goal of this thesis is to enhance FTSP – a popular time synchronization protocol for sensor networks – with an alternative linear regression implementation and compare its performance to the original implementation. You will first test alternative linear regression methods on a set of real traces gathered with FlockLab, our local testbed. Then, you will modify the TinyOS FTSP implementation running on Tmote Sky sensor nodes to integrate a new linear regression approach and optimize your code for efficiency and high precision computation.

This involves the following tasks:

- Run FTSP on the FlockLab testbed to obtain a set of communication traces to study alternative regression approaches in the context of multi-hop time synchronization.
- Enhance FTSP with an alternative regression approach to compensate for sensor drift and offset. Optimize your implementation for efficiency.
- Compare your implementation to the original protocol implementation.

FlockLab web page: www.flocklab.ethz.ch

Requirements: For this thesis you should have some knowledge of programming embedded systems and be interested in finding elegant solutions to complex problems.

Interested? Please have a look at http://www.tec.ethz.ch/research.html and contact us for more details!

Contacts

- Olga Saukh: saukh@tik.ee.ethz.ch, ETZ G82
- Roman Lim: lim@tik.ee.ethz.ch, ETZ G82