

MINEMA Short Visit Grants

Scientific Report

Grantee Data

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Visit Data

Starting Date: August 3th, 2008
Ending Date: August 8th, 2008
Host: Dr. Cecilia Mascolo
Institution: Computer Laboratory, University of Cambridge, UK

Context of Work

Reconfiguring the software running on wireless sensor nodes is of paramount importance to meet changing application requirements. Existing approaches have hitherto concentrated on static networks. In addition, they are usually not provided with the ability to limit the scope of reconfiguration to a subset of nodes identified with application information, e.g., all humidity sensors reporting a reading above 50%.

Nevertheless, the provision of this functionality in the mobile setting is equally important to enable long-running sensing applications, for instance, wildlife monitoring. In collaboration with the University of Cambridge, we are devising a programming model and distributed protocols to allow for fine-grained software reconfiguration in mobile environments. The objective is to give programmers the ability to change operating parameters or inject new functionality into the system by targeting only the subset of nodes of interest.

Purpose of the Visit and Description of Work Carried Out

The purpose of the visit was to refine the ideas that we are jointly developing with the group at Cambridge. Specifically, Bence Pasztor and Dr. Cecilia Mascolo at Cambridge are focusing on the routing layer enabling selective dissemination of code updates. Our visit to Cambridge, instead, aimed at refining the programming model enabling access to the routing functionality, and at designing its integration with the overall system.

During our stay there, we have been able to achieve the following:

- we precisely identified a motivating application scenario, as well as the requirements that must be satisfied from the point of view of programmers developing WSN applications in similar environments;
- based on the above, we explored two alternative design w.r.t. the language constructs made available to programmers to identify the subset of nodes involved in the software reconfiguration:

- the first design features a declarative language explicitly conceived for the system at hand. Firstly, we formally defined its syntax and semantics, and sketched its integration with the routing layer. Next, we tried to address the requirements of the motivating scenario using the language constructs made available in this case. We carried out a simple, qualitative evaluation of the result obtained, and identified the language expressiveness as the main advantage of this option, whereas we pointed out the need for programmers to learn an ad-hoc language as the main drawback.
- the second design revolves around an SQL-like syntax. Essentially, we leveraged the constructs made available by SQL to express the requirements on the data of interest to identify the properties of the nodes included in a given subset. We repeated the exercise above to address the requirements of the motivating scenario using these language constructs. Dually w.r.t. the above, our qualitative evaluation highlighted a faster learning curve for programmers, at the cost of slightly lower expressiveness.
- in light of the outcome of the above activity, we agreed with the group at Cambridge to go for the second option, and started adapting an existing SQL parser to address our needs.
- we planned the next steps, which include the following:
 - the group at Cambridge will focus on evaluating the performance of the routing protocol in large scale simulations;
 - we will concentrate on the implementation and integration of the SQL syntax described above with the routing layer;
 - following the above steps, we will carry out a synthetic evaluation of the system performance on real nodes, e.g., in terms of power consumption.

Finally, we agreed on a possible publication plan. We identified as a first, short-term goal a joint publication at a major conference in the field. We agreed that possible targets may be the Int. Conference on Information Processing on Sensor Networks (IPSN), or ACM/Usenix Middleware. Based on the feedback we will receive from the conference reviewers, we will consider a journal publication as a possible follow up.