Resource-Aware Task Scheduling in Wireless Sensor Networks

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I. Introduction

Wireless Sensor Networks (WSNs) are computer networks in which resource-constrained sensor equipment, which communicates over the air, is installed alongside more traditional machines. Applications include home automation and military scenarios.

In order for such networks to operate *autonomously*, the applications deployed on them must be able to cope with their *heterogeneity*: sensor devices are far less suited for heavy computation, but their mobility is an asset powerhouse servers do not have. At the same time, *energy efficiency* is a key issue. Distributing workloads over the topology at hand is therefore subject to many constraints.
Moreover, operations carried out in a sensor network can be modeled as a sequence of *tasks*. To order these efficiently while taking into account the constraints described above, *scheduling algorithms* will be devised and evaluated.

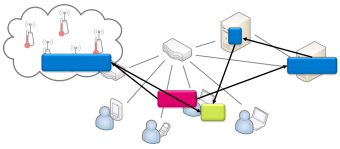

Figure 1. A sample WSN task schedule

Due to the dynamic nature of WSNs, devices may become unavailable at any time. *Adaptive* algorithms will therefore also be considered.

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II. Approach

As mentioned, task scheduling in heterogeneous network environments introduces many constraints. In fact, the underlying problem has been shown to be NP-complete. [1] Therefore, a twofold approach is being taken.

By formulating the problem as an *integer linear program*, the *branch-and-bound* algorithm can be used to obtain optimal schedules. However, due to vast amounts of memory required as well as increased execution time, such solutions will only serve as a reference.

The main goal of this research is to develop and assess *heuristic algorithms*, which produce suboptimal schedules, but are able to do so at a fraction of the computational cost required for ILP solution. By comparing these suboptimal solutions to optimal ones, the algorithms' efficiency can be quantified.

III. Conclusion

Our research has shown that algorithms based on *bin packing* heuristics produce acceptable schedules while requiring minimal resources. [2] Currently, the model is being extended and the algorithms evaluated on the IBCN research group's WSN testbed *WiLab*.

References

[1] D. Fernandez-Baca, *Allocating Modules to Processors in a Distributed System*, IEEE Trans. Soft. Eng., Vol. 15, Issue 11, 1989.

[2] T. De Pauw, S. Verstichel, B. Volckaert, F. De Turck, and V. Ongenae, *Resource-Aware Scheduling of Distributed Ontological Reasoning Tasks in Wireless Sensor Networks*, IEEE SUTC 2010, Newport Beach, CA, USA, 2010.