

Ilker Demirkol

Thesis Supervisor: Prof. Cem Ersoy

**“Medium Access Control Layer Performance Issues in
Wireless Sensor Networks”**

Abstract

Wireless sensor networks (WSNs) present a promising technology for many applications, providing an intelligent and remote observation of a destination. Among the various potential applications, there are health monitoring, disaster monitoring, habitat monitoring, precision agriculture, and surveillance systems. With the ongoing research both on new sensor types and on the hardware for improved computation, communication and power capacities, the emergence of novel application areas are expected.

Due to the limited power sources of the sensor nodes which are generally irreplaceable, the WSN research is focused on the energy-efficient network operation. This energy concern requires new studies at each networking layer, including the medium access control (MAC) layer. In this thesis, we investigate a number of MAC layer performance issues for WSN by first presenting a comparative survey of different MAC protocol schemes proposed in the literature. For the correct performance evaluation of the protocols, one needs to utilize a realistic packet traffic model that reflects the specific features of the WSN application represented. We derive an analytical packet traffic model for Surveillance WSN where sensor nodes inform the sink for detected intrusion events. The sensor detection model used is probabilistic and parametric, which enables the adaptation of the packet traffic model to the sensor types deployed.

One important contribution of this thesis is the optimization of the MAC layer contentions for minimization of the energy consumption or the delay incurred in contention slotted medium access protocols. This is achieved by analyzing the energy consumption and the contention delay and, then, extracting the contention window size that optimizes the corresponding performance metric. For its practical implementation in the distributed environment of WSNs, a method is proposed which achieves near-optimal performance values.

To investigate the effect of the contention optimization on the the overall network performance, video sensor networks (VSNs) are studied. VSNs are a special type of WSNs where the sensor nodes are equipped with cameras and send image or video of a target area based on the specifications of the application. First, the network performance of the VSNs are investigated via simulations for the currently available hardware technology. Then, by applying the contention optimization proposed in this thesis, we show how the capacity of VSNs can be improved with intelligent contention window size setting.

PUBLICATIONS

Journal Papers:

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3. I. Demirkol, "Evaluation of cluster-based cross layer protocols for wireless sensor networks," Accepted to IEEE INFOCOM 2006 Student Workshop, 2006.
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2. I. Demirkol, K. Basol, O. B. Orhan and S. Sevinc, "Sorgu-tabanlı telsiz algılayıcı ağları sınama ortamı çalışmaları," Proceedings of Bilgi Teknolojileri Kongresi, pp. 449-454, Denizli, Turkey, 9-11 February 2006.

Defense Jury Members

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|------------------------------|-------------------------------|
| 1. Prof. Cem Ersoy | Boğaziçi University |
| 2. Assoc. Prof. Fatih Alagöz | Boğaziçi University |
| 3. Prof. Hakan Deliç | Boğaziçi University |
| 4. Prof. Sema Oktuğ | Istanbul Technical University |
| 5. Assist. Prof. Tuna Tuğcu | Boğaziçi University |

Defense Date: 13.06.2008