Effects of transmit-based and receive-based slot allocation strategies on energy efficiency in WSN MACs

Alper Karahan a,⇑, Ismail Erturk b, Sedat Atmaca a, Suleyman Cakici c

a Department of Electronics & Computer Education, Kocaeli University, Turkey
b Turgut Ozal University, Ankara, Turkey
c Duzce University, Duzce, Turkey

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Abstract
In this work, the effects of time Slot Allocation Strategies (SASs) on node energy consumption for time slot assignment-based Medium Access Control (MAC) protocols, generally preferred in Wireless Sensor Networks (WSNs) for energy efficiency, are comparatively studied. As Wireless Nodes’ (WNs) energy consumption in WSNs determines the lifetime of network, it is of critical importance for application designers to know the best SAS to apply. Energy efficiency in WSNs can be maximized by employing an appropriate MAC while (i) assigning wireless medium resources efficiently and fairly among the WNs, (ii) minimizing packet collisions and (iii) avoiding overhearing. This paper aims at presenting and comparing the energy efficiency of transmit-based and receive-based SASs for multi-hop topologies used in WSN MAC. We have developed, modeled and analyzed both transmit-based and receive-based strategies. Based upon analytical models, comparative performance evaluations are presented. Besides, a detailed simulation study is carried out in a sample networking scenario by utilizing the OPNET Modeler software in order to confirm the analytical results. The study concludes that the receive-based SAS is at least five times more energy efficient than the transmit-based strategy in multi-hop network topologies, which is highly beneficial information to the WSN MAC designers.

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1. Introduction

⇑ Corresponding author. Tel.: +90 2623032269.
E-mail addresses: alper.karahan@kocaeli.edu.tr (A. Karahan), ierturk@turgutozal.edu.tr (I. Erturk), sedatatmaca@kocaeli.edu.tr (S. Atmaca), suleymancakici@duzce.edu.tr (S. Cakici).

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