Brief Announcement: MOGRIBA: Multi-Objective Geographical Routing for Biomedical Applications of Wireless Sensor Networks

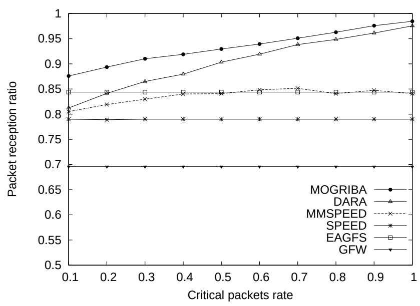
Djamel Djenouri[1] and Ilangko Balasingham[1,2]

[1] Department of Electronics and Telecommunications, NTNU, Trondheim, Norway
djamel.djenouri@iet.ntnu.no
[2] Interventional Center, Rikshospitalet University Hospital, Oslo, Norway
ilangko.balasingham@medisin.uio.no

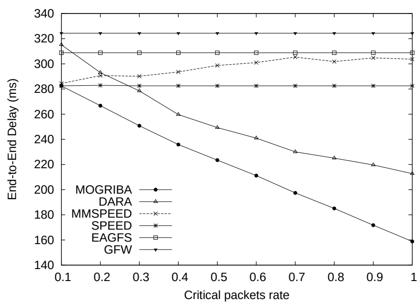
Abstract. A new routing protocol for wireless sensor networks is proposed in this paper. The proposed protocol focuses on medical applications, by considering its traffic diversity and providing a differentiation routing using quality of service (QoS) metrics. The design is based on modular and scalable approach, where the protocol operates in a distributed, localized, computation and memory efficient way. The main contribution of this paper is data traffic based QoS with regard to all the considered QoS metrics, notably reliability, latency, and energy. To our best knowledge, this protocol is the first that makes use of the diversity in the data traffic while considering latency, reliability, residual energy in the sensor nodes, and transmission power between sensor nodes as QoS metrics of the multi-objective problem. Simulation study comparing the protocol with state-of-the QoS and geographical routing protocols shows that it outperforms all the compared protocols.

1 Solution Overview

The considered application consists of a typical health care scenario. Several biomedical sensors may be embedded in different parts of the patient's body to measure and transmit data either through wired or wireless links to a body sensor mote that acts as a cluster-head of the body sensor network. It collects raw data, makes the required processing if necessary (coding, aggregation, etc.), and sends results to the sink node(s) responsible for covering the patient's area and uploading the information into the health care server. We define two kinds of responsible sinks for each patient; primary sink and secondary sink. A separate copy of each message requiring high reliability is sent to both sinks. This increases reliability as only one correct reception is necessary for the system. We consider in this paper energy efficiency, reliability, and latency, which are all involved in the medical application scenario. Giving these requirements data traffic may be split into: i) regular traffic that has no specific data-related QoS need, ii) reliability-sensitive traffic, which should be delivered without loss, but can tolerate reasonable delay, iii) delay-sensitive traffic, which should be delivered within a deadline, but may tolerate reasonable packet loss, and finally iv) critical traffic, of high importance and requiring both high reliability and short delay, e.g, physiological parameters of a patient during a surgery. For each packet, the proposed protocol achieves the global objective by locally selecting the most power-efficient node that ensures the required QoS. For delay-sensitive packets a deadline for delivery at final recipients is considered together with energy when routing. Best effort is assured for reliability-sensitive packets by selecting the most reliable and energy-efficient routes. The two strategies are combined for critical traffic requiring both high reliability and hard deadline. Regular packets have no specific requirement, hence only energy-efficiency is taken into account for this type of packets. Energy-efficiency includes both residual energy and required transmission power, and the protocol balances the two criteria using a min-max algorithm. The proposed protocol was designed using a modular approach, and evaluated through a comparative simulation using GloMoSim. The proposed protocol, MOGRIBA, was compared with MMSPEED, DARA, EAGFS, SPEED, and a geographical greedy forwarding. The simulation setup consists of 900 nodes located in a 1800 m^2 area, and 1000 s of simulation time. Results depicted in Figures 1 (a) and (b) show MOGRIBA clearly outperforms all protocols, by ensuring low latency and high reliability.



(a)



(b)

Fig. 1. a) Packet reception ratio, b)End-to-end delay

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