Heterogeneous Energy and Traffic Aware Sleep-Awake Cluster-Based Routing Protocol for Wireless Sensor Network

Nura Modi Shagari, Mohd Yamani Idna Idris, Ismail Ahmedy, Hisham A. Shehadeh

Sensor nodes heterogeneity if not properly utilized could lead to uneven energy consumption and load imbalanced across the network, which degrades the performance of the network. Routing algorithms should try to achieve energy-efficiency and load-balancing among the heterogeneous nodes to prolong network lifetime. One of the solutions is by using duty-cycling in cluster-based routing such as in Sleep-awake Energy Efficient Distributed (SEED) clustering algorithm to minimize redundant transmission to achieve energy efficiency. However, this scheme suffers from idle listening problem, which lead to energy wastage across the network. Moreover, SEED cannot cope with an environment with sensor nodes with heterogeneous traffic rate. To cope with energy and traffic heterogeneity issues among sensor nodes, a traffic and energy aware routing protocol (TEAR) is proposed. TEAR avoids selecting node with low energy and high traffic rate for cluster head role to achieve load balancing. However, TEAR does not avoid redundant transmission from the sensor nodes that are in close distances. In this paper, we proposed a hybrid method called energy and traffic aware sleep-awake (ETASA) mechanism to improve energy efficiency and enhanced load balancing in heterogeneous wireless sensor network scenario. Unlike prior methods, in ETASA, the paired nodes alternate into sleep and awake mode based on node's energy and traffic rate. Moreover, we revised the conventional TDMA scheduling in SEED by allocating one slot for group of pairs in a cluster. This is done to address idle listening problem to minimize energy consumption. The proposed method improves the cluster head selection technique that selects high energy, low traffic and nodes with high number of pairs to improve balanced energy consumption. The proposed approach is evaluated and compared against the state-of-the-art baseline protocols. The result shows that the proposed ETASA has 16% and 15% lifetime improvements against TEAR and SEED.