An efficient backoff algorithm for IEEE 802.15.4 wireless sensor networks

ABSTRACT

IEEE 802.15.4 is one of the most prominent MAC protocol standard designed to achieve low-power, low-cost, and low-rate wireless personal area networks. The contention access period of IEEE 802.15.4 employs carrier sense multiple access with collision avoidance (CSMA/CA) algorithm. A long random backoff time causes longer average delay, while a small one gives a high collision rate. In this paper, we propose an efficient backoff algorithm, called EBA-15.4MAC that enhances the performance of slotted CSMA/CA algorithm. EBA-15.4MAC is designed based on two new techniques; firstly, it updates the contention window size based on the probability of collision parameter. Secondly, EBA-15.4MAC resolves the problem of access collision via the deployment of a novel Temporary Backoff (TB) and Next Temporary Backoff (NTB). In this case, the nodes not choose backoff exponent randomly as mentioned in the standard but they select TB and NTB values which can be 10–50 % of the actual backoff delay selected by the node randomly. By using these two new methods, EBA-15.4MAC minimizes the level of collision since the probability of two nodes selecting the same backoff period will be low. To evaluate the performance of EBA-15.4MAC mechanism, the network simulator has been conducted. Simulation results demonstrate that the proposed scheme significantly improves the throughput, delivery ratio, power consumption and average delay.

Keyword: WSNs; MAC; IEEE 802.15.4; CSMA/CA; Efficient backoff algorithm