Block Acknowledgment in IEEE 802.15.4 by Employing DSSS and CSS PHY Layers

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Abstract:

The IEEE 802.15.4 standard has been widely accepted as the de facto standard for WSNs, enabling to provide ultra-low complexity, cost and power for low-data rate wireless connectivity for wireless sensors. However, one of the fundamental reasons for the IEEE 802.15.4 standard Medium Access Control (MAC) inefficiency is overhead. In the context of our research, we have identified that WSNs may benefit from packet concatenation in practice. In this paper we propose and analyse the employment of a block acknowledgment mechanism to achieve channel efficiency in IEEE 802.15.4 nonbeacon-enabled networks for the Chirp Spread Spectrum (CSS) and Direct Sequence Spread Sp ectrum (DSSS) Physical (PHY) layers for the 2.4 Industrial, Scientific and Medical (ISM) band. The proposal of this new innovative MAC sub-layer protocol can also be considered as a future possible contribution to the standard itself.The throughput and delay performance is mathematically derived under ideal conditions, i.e., a channel environment without transmission errors. The proposed schemes are compared against IEEE 802.15.4 through extensive simulations by employing the OMNET++ simulator. We demonstrate that, for both PHY layers, the network performance is significantly improved in terms of throughput, end-to-end delay and bandwidth efficiency.