IEEE 802.15.4 MAC Layer Performance Enhancement by employing RTS/CTS combined with Packet Concatenation

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Abstract:
IEEE 802.15.4 Medium Access Control (MAC) layer does not include the Request-To-Send/Clear-To-Send (RTS/CTS) handshake mechanism, in order to overcome the hidden node problem that affects Wireless Sensor Networks (WSNs). In this paper we propose and analyse the use of RTS/CTS in IEEE 802.15.4 for the nonbeacon-enable mode. The proposed solution shows that by considering the RTS/CTS mechanism combined with packet aggregation we improve the network performance in terms of maximum throughput, minimum delay and bandwidth efficiency. In IEEE 802.15.4 with RTS/CTS, the backoff procedure process is not repeated for each data packet sent unlike the basic access mode of IEEE 802.15.4, but only for each RTS/CTS set. Therefore, the channel utilization is maximized by decreasing the deferral time period before transmitting a data packet. Our work introduces an analytical model capable of accounting the retransmission delay and the maximum number of backoff stages. The successful validation of our analytical model is carried out by comparison against simulation results by using the OMNeT++ simulator.