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Distributed receiver/receiver synchronization in wireless sensor networks: new solution and joint offset/skew estimators for Gaussian delays.

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Summary: This paper proposes a new synchronization protocol for wireless sensor networks (WSN). The proposed protocols is based on the receive/reieve approach, which was introduced by the Reference Broadcast Synchronization (RBS). This approach has been chosen for its lower time-critical path compared to the sender/receiver approach. Contrary to RBS upon which rely all current receiver/receiver solutions, the proposed one is totally distributed and does not depend on any fixed reference. The reference's function is balanced among all sensors, which eliminates the single point of failure shortcomings. RBS needs additional steps for exchanging reception timestamps. On the other hand, the proposed protocol allow these timestamps to be piggybacked to the regular beacons, reducing thus the overhead and energy consumption. The protocol deals with local synchronization and allows neighboring nodes to relatively synchronize with each other by estimating relative skews/offsets. Maximum Likelihood estimators (MLEs) are derived for channels with Gaussian (normal) distributed delays, and for both offset-only and joint offset/skew models. The Cramer-Rao Lower Bounds (CRLBs) are derived for each model and numerically compared with the MLE. Results show quick convergence of the proposed estimators' precision to CRLB. To our knowledge, this is the first distributed receiver/receiver solution that eliminates the need of a fixed reference while taking advantage of the receiver/receiver synchronization's precision.

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