A kernel module for pulse-coupled time synchronization of sensor networks

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Abstract

The biologically-inspired synchronization paradigm of pulse-coupled oscillators has received increased attention in the communications and sensor network communities as an appealing alternative to traditional packet-based synchronization strategies. Its inherent scalability, simplicity, and decentralized nature make pulse-coupled synchronization an attractive choice for time synchronization in wireless ad-hoc networks. However, in most current implementations, the pulse-coupled synchronization algorithm is coded in the application layer, which makes its performance susceptible to CPU processing load variations. Implementation of the pulse-coupled synchronization strategy in the physical layer is also reported, which however, is subject to difficulties in migration between different platforms. In this paper, we present the design, implementation, and evaluation of the pulse-coupled synchronization strategy as a Linux kernel module. Our goal is to leverage the high portability and prioritized CPU access of kernel modules to 1) reduce the influence of disturbances from application layer programs on the synchronization performance; and 2) simultaneously make the synchronization strategy easily installable in Linux-based sensor networks. Both lab experiments and field tests were conducted to confirm the effectiveness of the results.

Keywords: Pulse-coupled synchronization||Kernel module||Time synchronization||Sensor networks
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