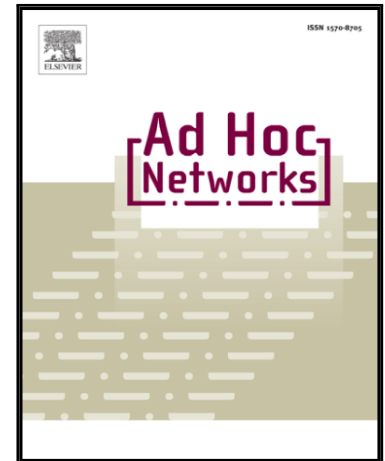


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Efficient Clock Synchronization for Clustered Wireless Sensor Networks

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Abstract

Establishing a unified time reference may be required for the operation of Wireless Sensor Networks (WSNs). Such a requirement may be imposed by the management strategy in the network, e.g., using time based medium access arbitration, or simply due to the dynamic nature of the application, e.g. target tracking. Contemporary clock synchronization protocols introduce significant messaging overhead and thus do not suit the resource-constrained WSNs. In the paper, we propose a novel solution called Synchronization through Piggybacked Reference Timestamps (SPiRT). SPiRT exploits the popularity of two-tier network architectures in WSN, where nodes are grouped into disjoint clusters. Each cluster-head synchronizes its clock to that of a reference node in the network through message exchange. Since cluster members can overhear the cluster-head transmissions, SPiRT takes advantages of such synchronization traffic to adjust the clock of the cluster members. SPiRT calls for appending the reference timestamps in the cluster-head messages so that a cluster member can estimate their clock adjustment. This cuts on energy consumption and increases the synchronization efficiency of SPiRT. We further propose an extension of SPiRT (E-SPiRT) that operates over multi-hop in order to achieve network-wide (global) synchronization. SPiRT and E-SPiRT are validated through simulation and implementation on a Micaz based testbed. The validation results confirm the effectiveness of SPiRT and E-SPiRT and show that they outperform competing schemes in the literature.

Keywords: Time synchronization, Receiver-Only synchronization approach, Wireless sensor networks.

1. Introduction

A clock synchronization service opts to established a unified time reference and mitigates the effect of varying clock drift rates at the individual nodes.

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