

Demonstrating H-NAME - A Hidden-Node Avoidance Mechanism for Wireless Sensor Networks

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In the last few years, wireless networking communities have been directing increasing efforts in pushing forward *anywhere and anytime* distributed computing systems. These efforts have led to the emergence of smart device networking, including Wireless Sensor Networks (WSNs), which represent enabling infrastructures for large-scale ubiquitous and pervasive computing systems. However, a limitation for the large-scale deployment of WSNs is the relatively poor performance in terms of throughput due to the use of contention-based Medium Access Control (MAC) protocols, such as the CSMA (Carrier Sense Multiple Access) family. Such expectation is intuitively vindicated by the impact of the hidden-node problem, which is caused by hidden-node collisions.

The hidden-node problem has been shown to be a major source of Quality-of-Service (QoS) degradation in Wireless Sensor Networks (WSNs) due to factors such as the limited communication range of sensor nodes, link asymmetry and the characteristics of the physical environment.

A hidden-node (or “blind”) collision occurs when two nodes, which are not visible to each other (due to limited transmission range, presence of asymmetric links, presence of obstacles, etc.), communicate with a commonly visible node during a given time interval. This leads to the degradation of the following three performance metrics: (1) *Throughput*, which denotes the amount of traffic successfully received by a destination node and that decreases due to additional blind collisions; (2) *Energy-efficiency*, that decreases since each collision causes a new retransmission; (3) *Transfer delay*, which represents the time duration from the generation of a message until its correct reception by the destination node, and that becomes larger due to the multiple retransmissions of a collided message.

In the literature, several mechanisms (which we discuss in [2]) have been proposed to resolve or mitigate the impact of the hidden-node problem in wireless networks. However, to our best knowledge, no effective solution to this problem in WSNs was proposed so far.

In this demo we present H-NAME, a simple yet efficient distributed mechanism to overcome it [1, 2]. H-NAME relies on a grouping strategy that splits each cluster of a WSN into disjoint groups of non-hidden nodes and then scales to multiple clusters via a cluster grouping strategy that guarantees no transmission interference between overlapping clusters. We also show that the H-NAME mechanism can be easily applied to the IEEE 802.15.4/ZigBee protocols with only minor add-ons and ensuring backward compatibility with the standard specifications.

The feasibility of H-NAME was demonstrated via an experimental test-bed, showing that it increases network throughput and transmission success probability up to twice the values obtained without H-NAME.

- [1] A. Koubâa, R. Severino, M. Alves, E. Tovar, “Improving Quality-of-Service in Wireless Sensor Networks by mitigating “hidden-node collisions”, IPP-HURRAY Technical Report, HURRAY- TR-071113, April 2008. Submitted to a Journal.
- [2] R. Severino, “On the use of IEEE 802.15.4/ZigBee for Time-Sensitive Wireless Sensor Network Applications”, MSc Thesis, Polytechnic Institute of Porto, School of Engineering, October 2008.