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

Ricardo Severino¹, Anis Koubâa¹,², Mário Alves¹, Eduardo Tovar¹

¹ IPP-HURRAY! Research Group, Polytechnic Institute of Porto, School of Engineering (ISEP-IPP)
Rua António Bernardino de Almeida, 431, 4200-072 Porto, Portugal
² Al-Imam Muhammad Ibn Saud University, Computer Science Dept., 11681 Riyadh, Saudi Arabia
{rars, aska, mjf, emt}@isep.ipp.pt

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 lead 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.