SenseSIM: Sensor Network Simulator

by

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Abstract—In spite of the increasing demand for Wireless Sensor Network based simulators, we are still lacking a clear understanding of analytical and computational techniques, as well as best practices, to design resource allocation schemes, communication protocols, and self-organization algorithms for wireless sensor networks that will deliver, in a predictable and quantifiable fashion, the quality of service required for a given computational lifetime. There is an urgent need to develop simulation platforms that are useful to explore data mining approaches with a stack supporting both the networking issues and the distributed computing aspects of wireless sensor networks.

This research summary presents my cross-level simulation approach and discusses ongoing work in terms of optimizing query scalability, computational aspects of cross-layer power-aware protocol.

I. RESEARCH METHODS

The purpose of my PhD thesis lies in developing Lifetime models for methods in Computational aspects for Wireless Sensor Networks & Protocols. Results on the performance of network layer, medium access control schemes have been simulated for power-aware routing algorithms. These simulators where initially implemented in VC++ and then ported into standard discrete event engines such as GlomoSIM to calculate the power consumption losses due to collisions at single/multi hop for CSMA/B-MAC. In the new framework we study end-to-end scalability issues of the simulators for cross-layer analysis using Directed Diffusion MAC. Throughput is calculated by overloading test-bed parameters which are used by proactive table driven algorithm in routing decisions.  

II. COMPUTATIONAL ASPECTS

A. Computational Aspects at the MAC Layers

When the percentage of the sensors fail due to power drain the simulator calculates the average computational lifetime in terms energy consumed by the routing layer, IEEE MAC states of Tx, Rx & Idle and number of reliable queries successfully completed by the algorithm. The complexity of depletion of energy per node for dense deployment follows the PowerLaw = f(d) = kd^2 + o(d)^2.

B. Computational Aspects at the Network Layers

A routing protocol is considered scalable with respect to sensor network nodes, if the size of the necessary routing table on each node grows at a rate of O(log N), where N is the number of nodes in the network. SenseSIM routing implements LEACH, SPEED and Directed Diffusion which are scalable (see Benchmark-table) in terms of fixed resources. The work-in-progress results are shown in Fig 1, plots (a,b), in which it performs twice as fast compared to ns2. Plot (c) (see Throughput-table) shows the SenseSIM MAC throughput is as scalable as in ns2’s Directed Diffusion.

III. VERY LARGE SCALE DEPLOYMENT - RESULTS

Use of network layer clustering further enhances reliability as shown in LEACH simulations. Upper-bound (see Protocol-table) for power-aware routing including lower layer synchronization and idle processing is achieved using B-MAC state scheduling for Tx, Rx and Idle periods.