Abstract

Wireless Sensor Networks (WSN) have become a hot research and application topic, showing much promise to be entitled as the future generation miniature technology. Currently, researchers are developing various applications and infrastructure for different layers of WSNs. Showing correctness before implementation, by behavior simulation and functional verification, is essential for a sound design methodology. However, there is a lack of tools with good modeling and debugging support for this purpose. In order to fill this gap, we propose to extend Stateflow and Simulink [1] libraries to provide parameterized blocks of WSN components which can be used as building blocks to model and simulate a complete multi-node distributed WSN application.

Figure 1: Functional Design Verification of WSN application

As a first step towards this goal we modeled, by using Simulink and Stateflow, all the levels of the $E^2$RINA [2] (Energy Efficient and Reliable In-Network Aggregation) algorithm, which is an aggregation technique to elect the cluster leader in a sensor network. $E^2$RINA introduces an approach that combines the efficiency of the cluster-head algorithms with the robustness of the gossip algorithms. Every node plays the same role initially, transmitting and receiving packets randomly. At the end of the initial phase, the cluster leader is selected based on number of packets received from other nodes. The node that has been able to hear from the maximum number of nodes has become the cluster leader. The algorithm is depicted at the Figure 2.
To model the algorithm, a Stateflow block has been designed to model the behavior of EERINA algorithm; Simulink blocks such as pulse generators, uniform random number generators, multiplexers, etc. have been used model the rest of the protocol stack (MAC, radio, channel, etc). Scopes and Stateflow animation were used to analyze the behavior of the algorithm. After completion of behavioral analysis and functional design, the Stateflow model has been used as a reference to drive the implementation of the EERINA in MANTIS [3], which is an OS for wireless sensor network. The whole flow is depicted in Figure 3.

References: