Chapter 4
Performance of Wireless Sensor Networks for Different Mobile Event Path Scenarios

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ABSTRACT

In this paper, the authors investigate how the sensor network performs when the event moves with special movement path. Simulation results are compared with four scenarios: when the event is stationary, moving randomly, moving with simple 4 path, and boids path. The simulation results show that for the case when the event is moving randomly, the performance is the worst in the four scenarios. The characteristic of goodput decreases with the increase of number of sensor nodes. In the case of the boids model, the goodput is unstable when the $T_r$ is lower than 10 pps. The consumed energy characteristic increases with the increase of $T_r$. Simulation results show that the consumed energy of random movement is the worst among the four scenarios. The consumed energy of boids model is the lowest in four cases. This shows that the event movement with boids model can decrease the consumed energy in large scale WSNs.

INTRODUCTION

In recent years, technological advances have lead to the emergence of distributed Wireless Sensor Networks (WSNs) which are capable of observing the physical world, processing the data, making decisions based on the observations and performing appropriate actions. These networks can be an integral part of systems such as battle-field surveillance and microclimate control in buildings, nuclear, biological and chemical attack detection, home automation and environmental monitoring (Akyildiz et al., 2004; Younis et al., 2004).
Wireless sensor network simulation is an important part of the current research. A large number of algorithms were first implemented and evaluated using several network simulators. Recently, there are many research works for sensor networks (Giordano et al., 2004; Al-Karaki et al., 2004). In our previous work (Yang et al., 2006), we implemented a simulation system for sensor networks considering different protocols (e.g: AODV, DSR, DSDV, OLSR.) and different propagation radio models. In Marco et al. (2006), we analysed the performance of WSNs considering different topologies and Shadowing radio model. Also, we analysed the performance of our proposed simulation system. But, we considered that the event node is stationary in the observation field. However, in many applications the event node may move. For example, in an ecology environment the animals may move randomly. Another example is when an event happens in a robot or in a car.

In this work, we want to investigate how the sensor network performs in the case when the event moves with special movement path. We carry out simulations for lattice topology and TwoRayGround radio model considering Adhoc On-demand Distance Vector (AODV) protocol. We evaluate the performance of WSN for 4 scenarios: when the event is stationary, moving randomly, moving with simple 4 path and boids path. The simulation results have shown that for the case when event is moving randomly the performance is the worst in the four scenarios. The characteristic of goodput decreases with the increase of number of sensor nodes. In the case of boids model, the goodput is unstable when the $T_r$ is lower than 10 pps. The consumed energy characteristic increases with the increase of $T_r$. Simulation results show that the consumed energy of random movement is the worst among four scenarios.

**PROPOSED NETWORK SIMULATION MODEL**

In our WSN, every node detects the physical phenomenon and sends back to the sink node the data packets. We suppose that the sink node is more powerful than sensor nodes. In our previous work, the event node was stationary. In this work, we consider that the event moves with special movement path. We analyze the performance of the network in a fixed time interval. This is the available time for the detection of the phenomenon and its value is application dependent. A proposed network simulation model is shown in Figure 1.

**A. Topology**

For the physical layout of the WSN, two types of topologies have been studied so far: random and lattice topologies. In the former, nodes are supposed to be uniformly distributed, while in the latter one nodes are vertexes of particular geometric shape, e.g., a square grid. For lattice topology, in order to guarantee the connectedness of the network we should set the transmission range of every node to the step size, $d$, which is the minimum distance between two rows (or columns) of the grid (Allen et al., 2006; Cooper, 1993). In fact, by this way the number of links that every node can establish (the node degree D) is 4. Nodes at the borders have D = 2.

In the case of random networks, we suppose that the coordinates in the Euclidean plane of every sensor are random variables uniformly distributed in the interval $[0, L] \times [0, L]$. Snapshots of lattice and random networks generated in simulations are shown in Figure 2 and Figure 3, respectively.

**B. Radio Model**

In order to simulate the detection of a natural event, we used the libraries from Naval Research Laboratory (NRL) (Network simulator). In this framework, a phenomenon is modeled as a wireless
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