Chapter 10
An Efficient Agent Based Rumor Propagation for Wireless Sensor Networks

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ABSTRACT
In the context of Wireless Sensor Networks (WSNs), in this paper, the authors present a new agent based routing protocol named Fast Rumor Agents protocol (FRA). The FRA protocol optimizes the agent (respectively the query) propagation through the network preventing backward paths. With FRA, a rumor must have a straight trajectory, reducing the total overhead of the network. Performances comparisons of ZRR and FRA protocols show that the main contributions of FRA protocol are the reduction of time of path establishment, the overhead caused in the network, and consequently, the energy consumption.

1. INTRODUCTION
A wireless sensor network is a collection of sensor nodes (small sensing devices) and a sink node connected through wireless channels. These small devices can be used for building distributed systems for data collection and processing (Wang, Cao, Li, & Dasi, 2008). Nodes in wireless sensor networks have restricted storage, computational and energy capacity. The network as a hole is characterized by a limited life time due to the energy constraint. Generally, the sensor nodes detect events, performed desired measurements, process the measured data and transmit it to the sink node (Chalak, Sivaraman, Aydin, & Turgut, 2006). However, nodes may also generate queries to find events or locate data and services they are interested in within the network (Banka, Tandon, & Jayasumana, 2005; Zhang, Yu, Zhou, Lin, & Li, 2009). Sensor networks are suitable for data
collection within regions that human beings are unable or hard to reach, for example, battle fields reconnaissance, disaster (such as earthquake, fire, etc), and areas monitoring (Yu, Chen, Wu, & Jin, 2008). Other examples applications include health monitoring, intelligent building, etc. (Wang, Cao, Li, & Dasi, 2008).

Routing protocols in wireless sensor networks have to ensure good performances in terms of energy consumption, scalability and increasing network life time. Different routing and dissemination protocols were proposed for wireless sensor networks. Flooding was one of the earliest mechanisms used in routing and dissemination protocols. In Intanagonwiwat, Govindan, and Estrin (2000) flooding events and queries is used to find the shortest path, but more power consuming and bandwidth was generated as a result of broadcasting storm.

To preserve energy consumption, routing algorithms with mobile agents seems to be more suitable for wireless sensor networks (Braginsky & Estrin, 2002; Banka, Tandon, & Jayasumana, 2005). Instead of flooding technique, agents may be used to spread environmental and request information. They can cooperate to build optimal paths leading to events and queries. The problem with the agent based routing protocols, especially in environments with no geographical localization systems, is the spiral like routing paths and the non uniform distribution of agents in the network. The proposed Fast Rumor Agent protocol is designed to fix the spiral like routing path problem. In FRA protocol, a new agent propagation approach is introduced, allowing a fast agent transfer between nodes in the network.

Our propagation approach allows agents finding new zones and avoids coming back to the neighborhood visited zones which saves energy and time during path establishment.

The rest of this paper is organized as follows: Section 2 discusses related researches on agent propagation for routing in wireless sensor networks. The proposed FRA protocol is introduced in Section 3. Section 4 presents comparison and scalability results of the proposed FRA protocol, while the last section concludes the paper.

2. RELATED WORK

Rumor Routing (RR) (Braginsky & Estrin, 2002) and its variant Zonal Rumor Routing (Banka, Tandon, & Jayasumana, 2005) are the most closely random walk protocols related to our proposed FRA protocol. They both concerns environment cases where no geographic localization systems are available. The original Rumor Routing protocol attempts to solve the problem of the overhead caused by the previous protocols (Intanagonwiwat, Govindan, & Estrin, 2000) In RR, when a node in the network witnesses an event, an agent is created and the event is inserted into an EventList. For its next hop, the agent chooses an unvisited node among its neighboring nodes. If all the neighboring nodes were already visited, the agent will choose one of them randomly. Once broadcasted, the agent and all the neighboring nodes that hear the broadcast synchronize their EventList. The agent will continue its traveling until the expiration of its Time To Live (TTL). When a query is sent by a sink node, it travels the network blindly until it discovers a path to the event it is interested in. Only in the worst case, where the query cannot find a path to the event, it will be flooded. The drawback of RR is that it produces a highly non-uniform distribution of information due to the randomly choice of the next hop, when forwarding agents and queries. The agent path may be a spiral route around a restricted region in the network and the routes established between the sink and the source node are usually not the shortest one.

Zonal Rumor Routing (ZRR) proposed by Banka, Tandon, and Jayasumana (2005) is an extension of the RR protocol. It was proposed to solve the problem of the non uniform distribution of information. However, in ZRR, the topology of the network is reconsidered, since it is partitioned
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