Research Issues in Wireless Communications and Networking

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CHAPTER 20

A CRITIQUE OF ENERGY-EFFICIENT GEOGRAPHIC ROUTING SCHEMES IN WIRELESS SENSOR NETWORKS

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20.1 ENERGY-EFFICIENT GEOGRAPHIC UNICAST ROUTING PROTOCOLS

When wireless sensor networks (WSNs) are deployed with large number of sensor nodes for wide are network applications, conventional table-driven and on-demand routing techniques cannot be used [1, 2]. Firstly, the network routing table can grow uncontrollably for WSNs deployed for wide area network applications. Secondly, WSN with large number of sensor nodes cannot cope with exchanging routing tables until a stable network state is reached. The routing table is created by using Bellman-Ford algorithm in some routing schemes. However, routing tables are exchanged only by each sensor node with its neighbors which are known as the enclosure of the node. Forwarding data through these enclosures consumes considerably lesser energy resources than sending data directly to a node outside the enclosures. In another routing technique, the optimal routing path is selected from the minimal energy consuming routes and routes that maximize minimal residual energy resources with a parameter determining the tradeoff. This is a centralized algorithm where the sensor nodes have information about the residual energy resources of other nodes and energy needed to forward data along any two nodes in the WSN. In another research, the authors developed a protocol for redirecting traffic flow by taking data traffic flow from the shortest lifetime route and allocate it to the longest lifetime route. The data rate must be ascertained first before calculating the lifetime of the sensor nodes. A number of on-demand routing algorithms have been proposed to mitigate the incurred overhead in the course of exchanging information in WSN. The simplest and most fundamental type of on-demand routing protocol will broadcast a path discovery notification to the WSN and deduce the optimal route to the base station by the response from the nodes. Significant overhead will be incurred from this approach if there is large number of nodes. In order to limit the number of sensor nodes that will be tasked with rebroadcasting the path discovery notification, a number of techniques have been proposed [2, 3].

20.1.1 Operational Evaluation

In WSN, where positions of the sensor nodes determine the network topology, geographic routing is needed. In one of the research works in this area, minimum energy link-disjoint and node-disjoint routes are calculated by utilizing a minimum weight node-disjoint routing algorithm given that the network topology is known [4]. Greedy routing techniques have been proposed in research works that emphasize the minimization of transmission hops in a mobile WSN [4, 5]. By employing these techniques, routing tables are not exchanged as as in proactive routing algorithms and there is no broadcasting of path discovery notifications as in reactive routing techniques. Prior to the initial forwarding of data, the routing path is not ascertained and the sensor nodes make routing decisions locally. Data traffic along the same source-to-destination node pairs follows the same route. When greedy routing fails, these algorithms resort to a recovery mode which is denoted as planar graph routing. Planar graph routing is a recovery strategy which preserves the stateless property of greedy routing algorithms. Planar graph routing is also called FACE routing and perimeter routing. Some