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Path-overlap Avoidance in Multiple Route Construction for Mobile Relay on WSN

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Abstract

ENERGY is the most important resource in Wireless Sensor Network (WSN) [1], because it determines the lifetime of a sensor node. Since the sensor nodes are usually powered by limited power batteries, low energy consumption is very important, in order to prolong the network lifetime of WSN. In recent years, many researchers designed and developed techniques for prolonging the network lifetime of WSN [1,2]. One of the techniques is mobile relay [3,4,5]. The concept of mobile relay is that some movable nodes change their location so as to minimize the total energy consumed by both wireless transmission and locomotion. Mobile relay needs to determine an initial route, which describes the sequence of nodes used for relaying the data from a source node to a sink node, and then the relaying nodes change their location so as to reduce their energy consumption.

In previous studies, we have already proposed Battery-Aware Initial Route Construction-Dijkstra's algorithm (BAIR-D) for determining the initial route based on Dijkstra's algorithm [6]. This method can construct the optimal path in terms of given cost function. Further, the algorithm takes into account nodes' battery levels and avoids using nodes with low battery levels. However, when applying it to multiple sources, a problem arises. Since BAIR-D constructs the optimal path for each source, the constructed paths are necessarily overlapped with a high probability. The path-overlap increases the energy consumption of the nodes on overlapped paths. This makes the overloaded nodes go quickly down.

In this paper, we propose battery-aware multiple route construction with path-overlap avoidance (BMRC-POA). To overcome the problem in the conventional method, BMRC-POA finds the initial route for mobile relay with path-overlap avoidance. It avoids some nodes to be a relaying node for multiple source nodes. It also avoids the source node to be a relaying node to another source node. Avoiding path-overlap in multiple route construction can save the energy for some sensor nodes. Therefore, it can prolong the lifetime of sensor nodes. This method consists of two steps. First, the initial route construction for every source node is determined without path-overlap. Second, if some source nodes have no route, then the initial route construction is performed with a path-overlap scenario. We compare BMRC-POA and BAIR-D in terms of the number of operating rounds and the successful rate of initial route construction. Further, we compare both of the methods in terms of the total cost. The effectiveness of BMRC-POA is demonstrated by using numerical simulation.

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