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Greedy routing life time consideration on Location base routing in wireless sensor Networks

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Abstract. Life time issue is a one of the most interested open issues in wireless sensor networks. Increasing life time is very important in WSNs and because of energy limitation the sensors will die and the networks cannot sense. value of different network topology lifetime are important for researchers to comparison their results.. In this paper we calculate the life time of the network base on greedy routing in localized routing.

Key words: Greedy Routing; life time; sensor networks

1. Introduction

Wireless sensor network/ad hoc is a collection of wireless devices distributed over a geographic region. Each sensor device is equipped with an omnidirectional antenna. A communication session is established either through a single hop radio transmission if the communication party is close enough, or through relaying by intermediate devices otherwise. The selection of intermediate relay nodes is determined by routing algorithms. Greedy forward routing (abbreviated by GFR) is one of the localized geographic routing algorithms proposed in literature. In GFR, one node discards a packet if none of its neighbours is closer to the destination of the packet than itself, or otherwise forwards the packet to the neighbor closest to the destination. Therefore, each packet should contain the location of its destination, and each node only needs to maintain the locations of its one-hop neighbors. GFR can be implemented in a localized and memory less manner. There are some variations of GFR. For example, in [1] and [2], the shortest projected distance to the destination on the straight line joining the current node and the destination node is considered as the greedy metrics. In [1] , packets are allowed to be sent backward if there is no forwarding neighbor. In [2], only nodes whose Voronoi cells intersect with the source destination line segment are eligible for being relay nodes. Here the Voronoi cell of a node is the set of points in the plane that are closer to the node than to any other node [3]. The analytic work of GFR can be dated back to 1984 by Takagi and Kleinrock [1]. They studied the optimal transmission radius to maximize the expected progress of packets based on most forward and least backward routing strategy in which every node delivers each packet to the neighbor (not including itself) with the shortest projected distance to the destination on the straight line joining the current node. However, the deliverability of packets is not considered. Recently, Xing et al. [2] (2004) show that in a fully covered homogeneous wireless sensor network, if the transmission radius is larger than 2 times of the sensing radius, the deliverability can be guaranteed between any source-destination pair by greedy forwarding schemes in which a packet is sent to the neighbour either with the shortest Euclidean distance to the destination [4, 5] or with the shortest projected distance to the destination on the straight line joining the current node and the destination node [1] and by bounded Voronoi greedy forwarding scheme in which only those nodes whose Voronoi cells intersect with the line segment between the source and destination are eligible to relay the packet. Another related and interesting problem in literature is the longest edge of connected geometric graphs. Penrose [6] (1997) [7] (1999) studied the longest edge of a minimal spanning tree which is corresponding to the critical transmission radius for connectivity in random geometric graphs. Later, by applying the percolation theory, Gupta and Kumar [8] had similar results for wireless networks.

Recently, Baccelli and Bordenave [9] (2007) introduced a structure called radial spanning trees (RSTs) in which each node, excluding the root s at the origin of the plane, has an edge to its closest neighbor among nodes closer to the root s. In this paper we focus on greedy algorithm and estimate lifetime on it.

2. Routing algorithms in planar network topologies

There are many routing algorithm on the various planar network topologies (see fig 1) [9] as a Compass rout Compass Routing (Cmp) [10], Random Compass Routing (RndCmp) [10], Most Forwarding Routing (MFR) [11], Nearest Neighbor Routing (NN), Farthest Neighbor Routing (FN) and Greedy Routing (Grdy) definition of greedy routing is: let t be the destination node. Current node u finds the next relay node v such that the distance vt is the smallest among all neighbours of u in a given topology. See [11]. The mentioned routing can run on the some different graph as relative neighbourhood graph, Yao graph, Delaunay triangulation and so on (see fig 1). The mentioned graph is planner graph. In graph theory, a planner graph is a graph that can be embedded in the plane (i.e. it can be drawn on the plane in such a way that its edges intersect only at their endpoints). In other words, it can be drawn in such a way that no edges cross each other.

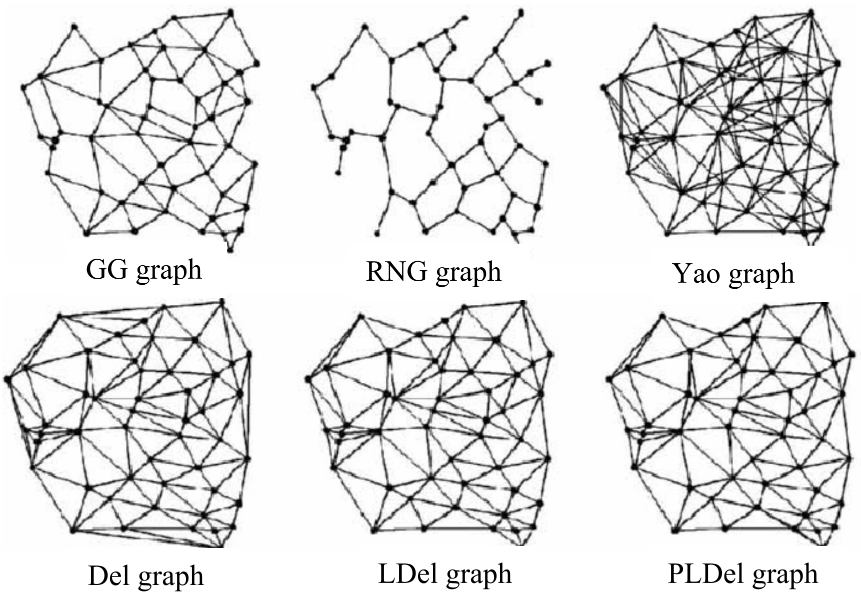

Fig.1. various planar network topologies

We are focusing on the greedy routing on the random planner graph. Due to existence of local minima where none of neighbours is closer to the destination than the current node, a packet may be discarded before arriving its destination. To ensure that every packet can arrive its destination, all nodes should have sufficiently large transmission radii to avoid being local minima [12]. For points $x, y \in \mathbb{R}2$ and a positive real number r, let $B\ (x, r)$ denote the open disk of radius r centered at x, $\|x\|$ denote the Euclidean norm of x, and $\|x - y\|$ denote the Euclidean distance between x and y. Consider Fig. 2. Let u be a source or relay GG graph RNG graph Yao graph PLDel graph LDel graph Del graph node, v be the corresponding destination node, and w_i denote nodes other than u and v. Nodes that can relay packets for u toward v must be in the region $B(u, \|u - v\|) \cap B\ (v, \|u - v\|)$ based on the following observations. If w_i can relay packets for u toward v, it must be closer to v than u, i.e. $\|u - w_i\| < \|u - v\|$ or equivalently $w_i \in B\ (v, \|u - v\|)$. w_2, w_3, w_4 satisfy this rule and w_1 does not. On the other hand, if no one can relay packets for u, packets should be directly transmitted from u to v. So, in the worst case, u at most needs to set its transmission radius to $\|u - v\|$.

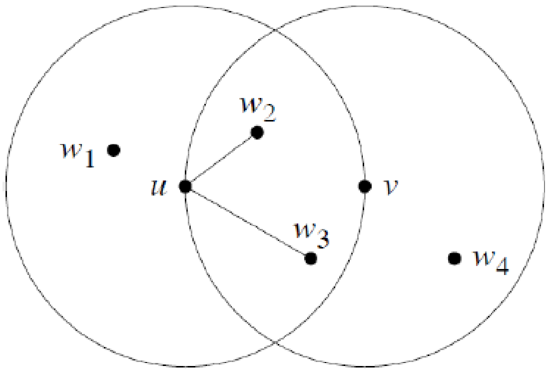

Fig.2. u is a source node and v is the corresponding destination node.

This implies candidates of relay nodes must be in $B\ (u, \|u - v\|\ )$ [12] .For example, in Fig. 2, w_4 can't be a candidate of relay nodes. Thus, only w_2 and w_3 can relay packets for u toward v. In addition, if the transmission radius is set to min $(\|w_2 - v\|\ , \|w_3 - v\|)$, u has at least one neighbor to relay packets. The procedure of selecting the minimal transmission radii to ensure either u can send packets directly to v or there exists at least one node to relay packets for u toward v can be expressed as $min(w_i \in B\ (v, \|u - v\|\ )\ \|w_i - u\|$. In the next section we want to consider the life time in by greedy routing on a planer graph.

3. Simulations

We have run simulation for the greedy routing for 30 nodes in a 1×1 unit area with node transmission range 0.3. In each time two nodes is selected randomly and a packet is routed from source to destination and source node and destination node and relay nodes increase their counter to obtain energy consumption then to use for obtaining life time. The simulator transfers a frame 50000 times between two random selected nodes on a

Table.1. The delivery rate for Greedy routing methods on different topologies graphs.

Graph	Rate
GG graph	99.6%
RNG graph	87.5%
Yao graph	100%
Del graph	100%
LDel graph	100%
PLDel graph	100%

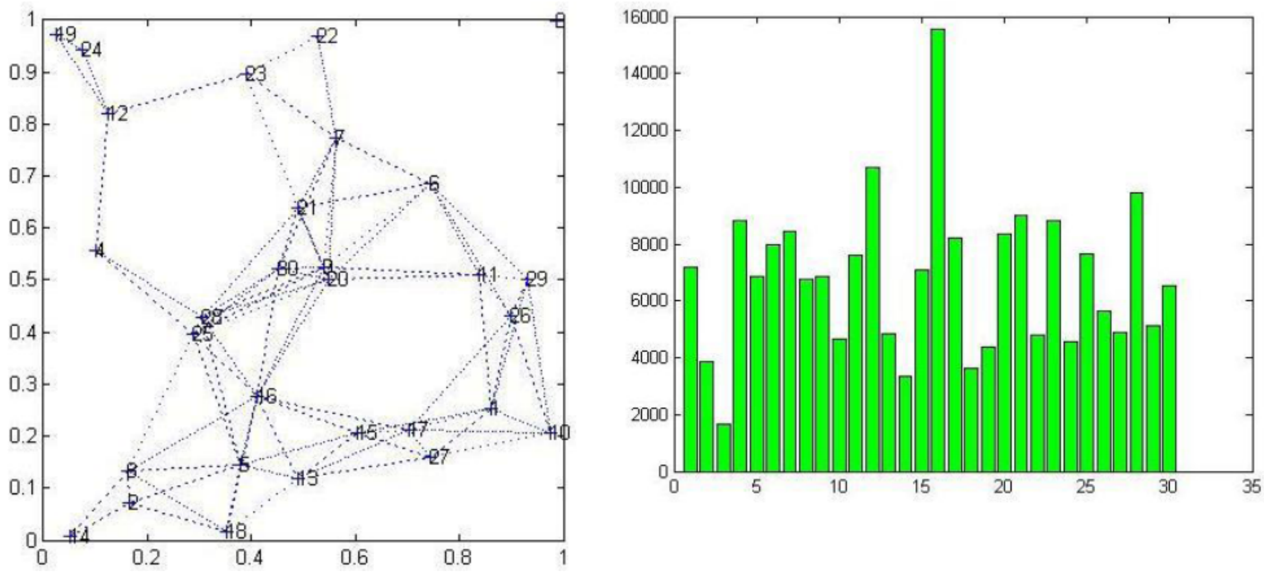

Fig 3. A random graph 1 and number of node transfer/relay data for each node.

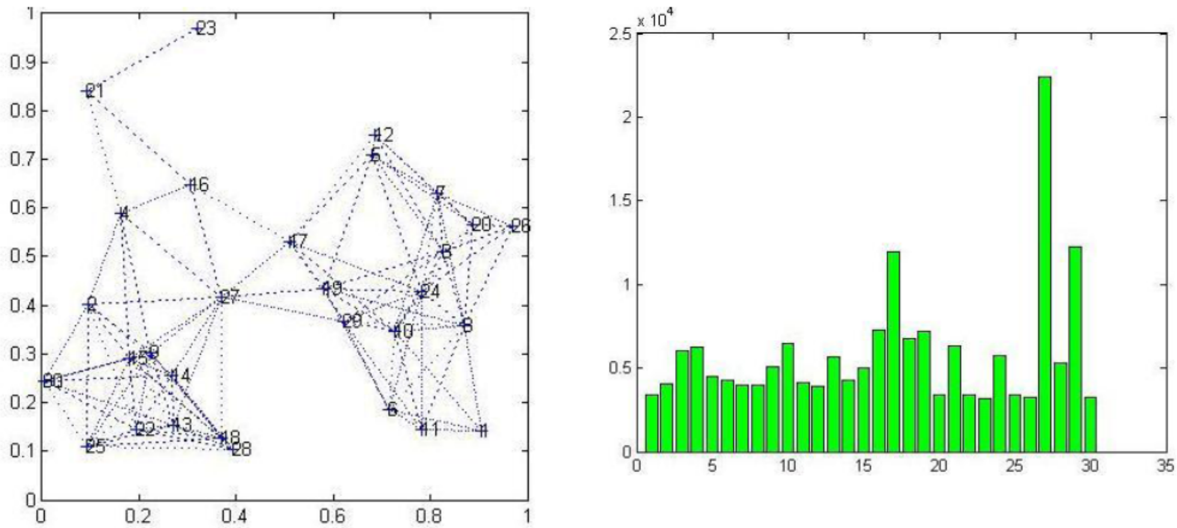

Fig 4. A random graph 2 and number of node transfer/relay data for each node

The result shows that nodes are on the face of the graph, consume energy less than others, and nodes are in the centre of the graph use more energy than other nodes. Each node is connected with more edge, relay more energy as result they are died sooner than others (see Fig 3 and Fig 4). Also, the result for 100 nodes show the delivery rate for Yao graph, Del graph, LDel graph and PLDel graph is 100% (see table1).

4. Conclusion

One of the most interested open issues in wireless sensor networks is life time issue. In WSN life time is very important because the sensors have limited energy and they will die after lost their energy so that the networks cannot continue to work normally. We have considered greedy routing on the life time in the random planer graph The result shows that nodes are on the face of the graph, consume energy less than others, and nodes are in the centre of the graph use more energy than other nodes. Each node is connected with more edge, relay more energy as result they are died sooner than others.

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