Research Survey on An Energy Efficient Algorithm for Routing Around Connectivity Holes In Wireless Sensor Networks

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Abstract- *In wireless sensor networks (WSN), building efficient and scalable protocols is a very challenging task due to the limited resources available and dynamics. Geographic routing protocols, that take information of each node location, are very valuable for wireless sensor networks. The state required to be maintained should be minimum and low overhead, addition to their fast response to dynamics. The routing protocols are in charge of discovering and maintaining the routes in the network. The appropriateness of a particular routing protocol mainly depends on the capabilities of the nodes and on the application requirements. An overview of geographic routing and load balancing protocol is presented in this paper. In this paper we mainly focus on ALBA-R, a protocol for converge casting in wireless sensor networks. ALBA-R is the cross-layer integration of geographic routing with contention-based MAC for specific relay selection and load balancing (ALBA), also a mechanism to detect and route around connectivity holes (Rainbow). ALBA and Rainbow together solves the problem of routing around a dead end without overhead-intensive techniques such as graph planarization and face routing.*

Keywords- WSN, MAC, Cross-Layer Routing, Connectivity Holes, Geographic Routing, ALBA-R

I. INTRODUCTION

Distributed sensing environment and seamless wireless data gathering are main ingredients of several monitoring applications implemented through the dissemination of wireless sensor networks. There are various routing techniques that have been proposed so far and several of these have been already explicitly implemented and are working good. The sensor nodes perform their data collection duties with the Unattended, and the corresponding packets are then transfer to the sink using multihop wireless routes (WSN routing or convergecasting). The main research on protocol design for WSNs has mainly focused on MAC and routing solutions. Various mobile ad-hoc networks (MANETs) are infrastructure free networks of mobile nodes that communicate with each other in wireless mode. The applications of such networks have been in disaster relief operations, conferencing, military surveillance, and environment capturing. Several ad hoc routing algorithms at present that utilize topology information to make routing decisions at each node in the network. An important class of protocols is mentioned by geographic or location-based routing scheme are present in which path is chosen via greedy approach it provides toward the sink. Due to almost stateless, distributed and localized, geographic routing requires little computation and storage resources at the nodes and is therefore very attractive for WSN some applications.

The wireless sensor network is built of nodes from a few to several hundreds or even more, where each node is connected to one (or sometimes several) sensors present in the network. Cross layer mechanism can be used to make the optimal modulation to improve the transmission performance.

One or more base stations provide much more computational energy and communication resources to the sensors. Which are acting as a gateway between sensor nodes and the end user; they typically forward data from the WSN on to a server.

Routers are one among the important components of WSNs, which are designed to compute and calculate and distribute the routing tables. Georouting routing (also called geographic or position-based routing) is a routing principle that relies on geographic position information and it is based on the idea that the source sends a message to the geographic location of the destination instead of using the network address. In geographic routing, each node can determine its own location and source node is aware of the location of the destination node. Thus the information can be routed to destination without prior route discovery or knowledge of the network topology.

Greedy forwarding technique adopted by most single path strategies tries to bring the message closer to the sink in each step using only local information. Thus every node forward packets to the neighbor which is most suitable from a local point of view, node which minimizes the distance to the destination is the most suitable neighbor. Whenever there is no neighbor closer to the destination, greedy forwarding can lead into a dead end.

Connectivity holes are inherently related to the way greedy forwarding approach works. In a fully connected topology, there may exist nodes which are known as dead ends that have no neighbors that provide packet transmission toward the destination. SO the dead ends are unable to forward the packets they generate or receive. So these packets will never reach their destination and will eventually be discarded. There are several geographic routing schemes fail to fully address important design challenges includes,

i) Routing around connectivity holes
ii) Resilience to localization errors
iii) Efficient relay selection

So the main objective is of this paper is to provide load balancing among the nodes and to overcome the packet loss and dead-ends. ALBA mechanism performs load balancing based on key generation, splitting of packets and signature on data. Here the splitting of packets is based on number of inputs.

II. LITERATURE SURVEY

Ding, Sivalingam, Kashyapa [1] considered the problem of finding a route from a sensor to the single sink in a wireless sensor network. Consisting a reactive route discovery strategy, sink floods the network and sets the routes. Here the difference is that each sensor does not memorize the whole route, but instead it only memorizes its hop count distance to the destination. When a packet is sent toward the destination, any neighbor at one less hop distance can forwards it, Instead of reporting back to the first node that sent task assignment packet to it.

Geographic routing mainly considers transmitting a packet in the direction of its particular sink by giving maximum per-hop advancement. The geographic routing over planarized wireless sensor networks is obtained by employing greedy routing as possible and the resorting to planar routing only when required, to get over around connectivity holes. The spanner graph of the network topology needs to be built and this incurs no negligible overhead. Therefore planar routing may then require the exploration of large spanners before being able to switch back to the more efficient greedy forwarding approach, thus importing higher latencies [2].

Jean-Yves and Le Boude etal. [5] explain an inclusive review on drawbacks on geographical routing where greedy forwarding approach is used, that is destination distance is too long means packet gets discarded because greedy forwarding algorithm works based on shortest path first and tells about various location based routing protocols and their drawbacks are like location based routing is difficult when there are holes in the network topology and nodes are mobile or frequently disconnected to save battery and tells about terminate routing protocols.

Another different approach for handling dead ends is based on embedding the network topology into coordinate spaces that decrease the probability of connectivity holes. Greedy forwarding is mainly performed over the virtual coordinate's space and this reduces the appearance of dead ends, but it does not removing these ends. Various topology wrapping schemes are mainly depends on iteratively updating the coordinates of each node based on the coordinates of its neighbors so that greedy paths are more exist. These approaches are known as "geographic routing without location information," as they do not require accurate initial position estimates [3], [4].

III. GEOGRAPHIC ROUTING TECHNIQUES

Geographic routing is a technique to deliver packets to a node in a network over multiple hops by means of position information. The routing decisions are not based on network addresses and routing tables instead, packets are routed towards a destination location. With knowledge of the neighbor's location, each node can select the next hop neighbor that is closer to the destination, and thus advance towards the destination in each step. The fact that neither routing tables nor route discovery activities are necessary makes geographic routing attractive for dynamic networks such as wireless ad hoc and sensor networks. In such networks, acquiring and maintaining routing information is costly as it involves additional message transmissions that require energy and bandwidth and frequent updates in mobile and dynamic scenarios.

Geographic routing algorithms use position information for making message forwarding decisions. Not similar to topological routing algorithms they do not need to exchange and maintain routing information and work nearly stateless. This makes geographic routing attractive for wireless adhoc and sensor networks.

Planar Graph

Planar graph routing, which guides the packet around the local minimum and guarantees delivery, required that a planar sub graph of the network graph can be constructed in Figure 4. Therefore, recovery methods have been developed, the most prominent of which are based on planar graph routing, where the message is guided around the local minimum by traversing the edges of a planar sub graph of the network communication graph[14]. Planar graph routing techniques can provide delivery guarantees under certain assumption. Altogether, greedy forwarding in combination with a recovery can be considered as state-of-the-art technique in geographic routing.

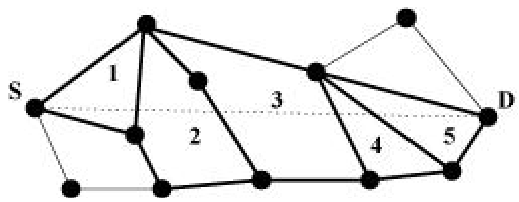

Fig 1 planar graph

Greedy Forwarding

Most geographic routing algorithms use a greedy strategy that tries to approach the destination in each step [13], e.g. by selecting the neighbor closest to the destination as a next hop depicted in Figure 3. However, greedy forwarding fails in local minimum situations, i.e. when reaching a node that is closer to the destination than all its neighbors. A widely adopted approach to solve this situation is planar graph routing.

A simple greedy forwarding by minimizing the distance to the destination location in each step cannot guarantee message delivery. Nodes usually have a limited transmission range and thus there are situations where no neighbor is closer to the destination than the node currently holding the message. Greedy algorithms cannot resolve such dead-end or local minimum situation.

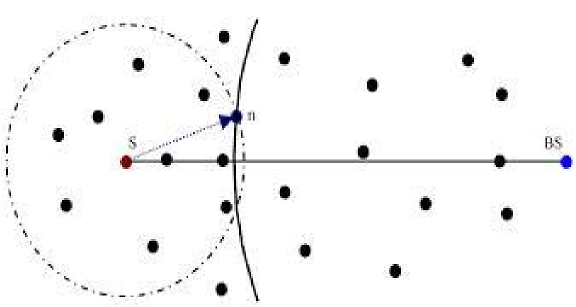

Fig. 2 Greedy forwarding

The current geographic routing schemes fail to fully address some important design challenges, including

i) Routing around connectivity holes
ii) Resilience to localization errors
iii) Efficient relay selection.

be generated. Each level is associated with status of heart which shows the score.

IV. METHODOLOGY

To overcome the current geographic routing problems we proposed ALBA-R, a protocol for convergecasting in wireless sensor networks. ALBA-R is the cross-layer integration of geographic routing with contention-based MAC for relay selection and load balancing using adaptive load balancing algorithm (ALBA), also a mechanism to detect and route around connectivity holes (Rainbow).

Load-balancing is needed to effectively use available resources and keep the nodes energy consumption balanced by equally distributing the load to all nodes [6]. The problem is to route data packets avoiding congested path so as to balance traffic load over network and lower end-to-end delay. Distributing the load within the network has two advantages. Firstly the resource of the network is fully utilized through distributing network load. An efficient load-balancing routing protocol is able to improve packet delivery rate and network throughput. Secondly the energy consumption is balanced by equally distributed load due to which the network lifetime could be increases. A dynamic parameter less load-balancing geo routing protocols was proposed. The node holding the packet for delivery compares costs of sending the packet to all available neighbors that are closer to destination and not fully loaded, against the progress made. The cost is then increasing linearly with the consumed bandwidth.

Adaptive Load balancing algorithm

ALBA is a greedy forwarding protocol for Wireless sensor networks. It is designed to take congestion and traffic load balancing into consideration. All the eligible relays of a node compute two values first the Geographic Priority Index (GPI), i.e., the index of the region the node would belong to in the GeRaF (Geographic Rnandom Forwarding) [6] framework, second one is the Queue Priority Index (QPI), which is a measure of forwarding effectiveness as perceived by the relay.

ALBA, is a cross layer solution for convergecasting in Wireless sensor networks that integrates awake/asleep schedules, MAC, routing, traffic load balancing, and back-to-back packet transmissions. As nodes alternate between awake/asleep modes according to independent wake-up schedules with fixed duty cycle d So Packet forwarding is implemented by having the sender polling for availability its awake neighbors by broadcasting an RTS packet for jointly performing channel access and communicating relevant routing information (cross-layer approach). Available neighboring nodes respond with clear-to-send (CTS) packet carrying information through which the sender can choose the best relay so the relay selection is performed by preferring neighbors offering ―good performance‖ in forwarding packets. Positive geographic advancement toward the sink (the main relay selection criterion in many previous solutions) is used to discriminate among relays that have the same forwarding performance. Every prospective relay is characterized by two parameters: the queue priority index (QPI), and the geographic priority index (GPI).

Rainbow Mechanism

ALBA-R features the cross-layer integration of geographic routing addition with contention-based MAC for relay selection and load balancing (ALBA), and also a mechanism which detects and route around connectivity holes (Rainbow). ALBA and Rainbow (ALBA-R) together solve the problem of routing around dead ends without overhead-intensive techniques such as graph planarization and face routing methods.

The Rainbow mechanism allows ALBA-R to efficiently route packets out of and around dead ends. Rainbow is resilient to localization errors and to channel propagation impairments. It does not need the network topology to be planar, unlike previous routing protocols. It is, therefore, more general than face routing-based solutions and is able to guarantee packet delivery in realistic deployments.

V. CONCLUSION

Wireless sensor networks applications can be found in every field of life. One of the exigent problems occurring in such environment is the formation of network holes. It occurs when a group of nodes stop operating due to some reasons. Hole degrades the general performance of the networks. It destroys a major part of the network and leads to problems in data reliability and data routing.

The routing techniques are most relevant in the networking based methodologies. Various routing strategies are allowed different types of routing protocols based on topology planarization and greedy forwarding approach. In this paper a cross-layer relay selection mechanism favoring nodes that can forward traffic more effectively and reliably, depending on traffic and link quality. The proposed scheme designed to handle dead ends, Rainbow, is fully distributed and has low overhead also makes it possible to route packets around connectivity holes without resorting to the creation and maintenance of planar topology graphs. Rainbow is a mechanism which guarantees packet delivery under arbitrary localization errors that is at the sole cost of a limited increase of the route length.

This paper gave an idea about connectivity holes in wireless sensor networks and some routing techniques that route packets around these holes. The cross-layer routing named ALBA-R gives the best performance in case of routing around connectivity holes.

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