Discovering Optimum Forwarder List in Multicast Wireless Sensor Network

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Abstract
Routing Protocol design for wireless networks is problem area that has two essential requirements. Minimize energy cost and maximize network throughput. Wireless Sensor Network consists of sensor devices which sensors signals to other sensor devices. In order to sent packet form one sensor device to another, It uses concept of broadcasting i.e. it sends packet to all it neighbors. But this scheme requires more energy to minimize the energy cost of transmission, this proposed scheme finds optimum forwarded list. This paper focus on finding optimum forwarded list for transmission of the packet for source node to destination group. i.e. routing in multicasting. This paper also describes selecting and prioritizing forwarded list to minimize consumptions by all nodes. Simulation results shows that this protocol energy efficient multicast routing in wireless sensor networks (EEMRWSN) perform better in terms of energy consumption.

Keywords
Wireless Networks, routing, Multi casting

I. Introduction
A wireless ad hoc network consists of a distribution of radios in a certain geographical area. Unlike cellular wireless networks, there is no centralized control in the network, and wireless devices (called nodes hereafter) can communicate via multi-hop wireless channels: a node can reach all nodes inside its transmission range while two far-away nodes communicate through the relaying by intermediate nodes. An important requirement of these networks is that they should be self-organizing, i.e., transmission ranges and data paths are dynamically restructured with changing topology. Energy conservation and network performance are probably the most critical issues in wireless ad hoc (and sensor) networks, because wireless devices are usually powered by batteries only and have limited computing capability and memory. On-demand routing algorithms were originally proposed for mobile ad-hoc networks, which are autonomous systems of mobile hosts connected by wireless links. Ad-hoc radio networks containing mobile nodes suffer from a limited amount of bandwidth, and one way to reduce the amount of bandwidth consumed is to maintain routes to only those destinations for which a router has data traffic. In the past, the majority routing protocols in multi-hop wireless networks have typically followed this convention, including those multipath routing protocols. However, this convention did not take advantages of the broadcast nature of wireless communication: a node’s transmission can be heard by any node within its transmission range. In addition, the loss and dynamic wireless links make traditional routing protocol unsuitable as well, i.e., in multihop wireless networks, various factors, like fading, interference, multi-path effects, and collisions, can temporarily lead to heavy packet losses in the pre-selected good path. Opportunistic routing, however, introduces a difficult challenge. Multiple nodes may hear a packet broadcast and unnecessarily forward the same packet. ExOR deals with this issue by tying the MAC to the routing, imposing a strict scheduler on routers’ access to the medium. The scheduler goes in rounds. Forwarders transmit in order, and only one forwarder is allowed to transmit at any given time. The others listen to learn which packets were overheard by each node. Although the medium access scheduler delivers opportunistic throughput gains, it does so at the cost of losing some of the desirable features of the current 802.11 MAC. In particular, the scheduler prevents the forwarders from exploiting spatial reuse, even when multiple packets can be simultaneously received by their corresponding receivers. Additionally, this highly structured approach to medium access makes the protocol hard to extend to alternate traffic types, particularly multicast, which is becoming increasing common with content distribution 0applications [1] and video broadcast [2-3]. There is an open problem in the opportunistic routing design: how to select the appropriate forwarder list such that the expected energy cost is minimized? In this paper, describes this problem and propose our Energy Efficient Multicast Routing for Wireless Sensor Networks (EEMRWSN) protocol for wireless networks through rigorous theory analysis as well as extensive simulations, and studied the case where the transmission power of each node is fixed (known as non-adjustable transmission model) as well as the case where each node can adjust its transmission power for each transmission (known as adjustable transmission model). Optimum algorithms to select and prioritize forwarder list in both cases are presented and analyzed. Worth to mention that, our analysis do not assume any geometrical properties or energy models, and apply to dynamic multihop wireless networks. The rest of the paper is organized as follows. Section 2 explain how to calculate the expected energy cost using EEOR and present the algorithm to select energy cost optimum forwarder list. 3 rd Section present system design details of our implementation.

II. Related Work
Opportunistic routing has been introduced by Biswas and Morris, whose paper explains the potential throughput increase and proposes the ExOR protocol as a means to achieve it [1]. Opportunistic routing belongs to a general class of wireless algorithms that exploit multi-user diversity. These techniques use receptions at multiple nodes to increase wireless throughput. They either optimize the choice of forwarder from those nodes that received a transmission [1], or combine the bits received at different nodes to correct for wireless errors [2], or allow all nodes that overheard a transmission to simultaneously forward the signal acting as a multi-antenna system [3]. Main work builds on this foundation but adopts a fundamentally different approach; it combines random network coding with opportunistic routing to address its current limitations. The resulting protocol is practical, allows spatial reuse, and supports both unicast and multicast traffic.

Energy efficient routing has always been a central research topic in wireless networks, both in the paradigm of multicast/broadcast [2, 4, 7] and in the paradigm of nicest [5-6]. In both paradigms, our objective is to design a routing scheme such that the total transmission power is minimized. In this paper, we study the paradigm of unicast and refer interested readers to the literature for more knowledge on energy efficient Multicast/ broadcast.
routing. By using Dijkstra’s shortest path algorithm PAMAS finds a minimum cost path where the link cost is set to the transmission power. If every link in the paths is error free, then a single transmission over each link can successfully deliver a packet from the source to its destination with a minimum energy consumption. Scott and Bamboos studied the case where link costs include power consumption on the receiver side, and proposed to find energy efficient paths using a modified form of the Bellman-Ford algorithm. Some researchers have considered power aware routing in an alternative approach. The residual battery power is used as a routing metric, in order to achieve a more balanced distribution of power consumption among all the nodes so that the lifetime of the whole system may be increased. From our perspective, these schemes may result in less energy efficient routes. We refer the reader to the literature [5-6] for detailed information.

III. Problem Statement

consider a wireless Sensor network and assume that all wireless nodes have distinctive identities (i.e., \(i \in [1, n]\)) and each wireless node \(u\) has a maximum transmission power \(W\). In some cases, we assume that each node can adjust its transmission power to any value between 0 and \(W\). Let \(w\) denote such adjusted transmission power. The multihop 2 wireless network is then modeled by a communication graph \(G = (V, E)\), where \(V\) is a set of \(n = |V|\) wireless nodes and \(E\) is a set of directed links. Each directed link \((u, v)\) has a nonnegative weight, denoted by \(w(u, v)\), which is the minimum transmission power required by node \(u\) to send a packet to node \(v\). Our methods work with any weight assignment, in other words, the weights assigned to the communication links could be derived from any power attenuation model. The number of neighboring nodes of a node \(u\) changes with the power consumed at node \(u\) when sending a packet. Let \(Nw(u)\) denote the neighboring nodes of a node \(u\) when node \(u\) transmits with the power \(w\). For simplicity, when the subscript \(w\) is not mentioned, we mean that the node is using its maximum power i.e., \(N(u) = NW(u)\). Also each link \((u, v)\) has an error probability, denoted by \(e(u, v)\), which is the probability that a transmission over link \((u, v)\) is not successful. In other words, node \(u\) must consume at least \(w(u, v)\) power to have a chance of \(1 - e(u, v)\) to transmit a packet to node \(v\). No transmission is possible otherwise. To see how we take advantage of wireless multicast advantage (WMA), consider the contrived scenario in Figure 1. The error probability from the source to each node \(v_i\) is \(e\) and the error probability from each node \(v_i\) to the target node is 0. Traditional routing would route all the data through the same node during a routing-update period, so the packet has to be sent \(1 / (1 - e)\) times before being received by the intended node \(v_i\). However, by taking advantage of WMA property, the packet has to be sent only \(1 / (1 - en)\) times. The difference is more noticeable when \(e\) is close to 1 and \(n\) is a big number. In other words, the advantage of using WMA property is more noticeable in dense graphs with high error probabilities.

IV. Frame Work and Algorithm

In the above framework explains the Discovering Optimum Forwarded List in Multicast Wireless Sensor Network.network structure and energy &error details as input to the discovering forwarded list in multicast wireless sensor network it gives output as optimum Forwarded list with the help of Non-Adjustable and Adjustable methods.

**Algorithm 4 EEOR Packet Handling Protocol**

1. **Input:** Receiving a packet \(p\)
2. **if** \(p\) is a data packet **then**
3. **if** this is the first time for \(u\) to receive \(p\) **then**
4. broadcast(ACK\((p)\)); pktList\((p)\).status = PD;
5. save data packet \(p\);
6. **if** \(u.id = p.id\) **then**
7. Drop\((p)\);
8. pktList\((p)\).status = PD;
9. **if** \(u\) is in the forwarded list of \(p\) **then**
10. broadcast(ACK\((p)\)); pktPacketInBuffer\((p)\);
11. pktList\((p)\).status = PD;
12. **else**
13. pktList\((p)\).status = PD;
14. **if** pktList\((p)\).status = PD **then**
15. Drop\((p)\);
16. if pktList\((p)\).status = PO **then**
V. Results

The following graphs represent Compared protocol with ExOR with respect to the total energy consumption, packet loss rate, end-to-end delay and packet duplication ratio. We implement ExOR following the descriptions in [2]. To compare two protocols fairly, we use same max forwarder list size for both protocols and we let the each batch contain one packet in

![Fig. 3](image1)

**Fig. 3:**

![Fig. 4](image2)

**Fig. 4:**

VI. Conclusion

In the paper, investigated how to select and prioritize forwarder list to minimize energy consumptions for Multicast. We study both cases that the transmission power of each node is fixed or changeable. The algorithms to select and prioritize forwarder list in both cases are presented and analyzed. Worth to mention that, our methods do not assume any geometrical properties or energy models. We conducted extensive simulations in TOSSIM to study the performance of proposed algorithms by comparing it with ExOR.

References


