Sleep Scheduling using IEQGOR in Wireless Sensor Networks

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ABSTRACT— *QoS routing is an important research issue in wireless sensor networks (WSNs), especially for mission-critical monitoring and surveillance systems which requires timely and reliable data delivery. The existing research suffers from a limitation such as latency, delivery ratio and energy consumption. Based on the analysis and observation, Improved Efficient QoS-aware Geographic opportunistic routing (IEQGOR) has been proposed. IEQGOR integrates awake/asleep schedules, MAC, routing, traffic load balancing and back-to-back packet transmissions. It combines geographic routing, awake-asleep scheduling, and for achieving an energy-efficient data gathering mechanism. It selects the relay node, based on low traffic and link quality. A promising routing scheme in Wireless Sensor Network is shifting toward duty-cycled WSNs in which sensors are sleep scheduled to reduce energy consumption. Nodes alternate between awake/asleep modes according to independent wake-up schedules with fixed duty cycle. The availability of its awake neighbours can be identified by broadcasting an RTS packet for jointly performing channel access and communicating relevant routing information. Available neighbouring nodes respond with clear-to-send (CTS) packet carrying information through which the sender can choose the best relay. Relay selection is performed by preferring neighbours offering "good performance" in forwarding packets. It achieves remarkable delivery ratio, latency and can greatly limit energy consumption.*

Keywords—*wireless sensor network, QoS routing, improved efficient QoS aware geographic opportunistic routing, awake/asleep scheduling, geographic routing.*

I. INTRODUCTION

A Wireless Sensor Networks consists of spatially distributed autonomous sensors to monitor physical or environmental conditions such as temperature, sound, pressure, etc. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications such as industrial process monitoring and control, machine health monitoring, and so on. For target tracking applications, idle listening is a major source of energy waste. To reduce the energy consumption during idle listening, duty cycling is one of the most commonly used approaches. The idea of duty cycling is to put nodes in the sleep state for most of the time, and only wake them up periodically. In certain cases, the sleep pattern of nodes may also be explicitly scheduled, i.e., forced to sleep or awakened on demand. This is usually called sleep scheduling.

As a compensation for tracking performance loss caused by duty cycling and sleeps scheduling, proactive wake-up has been studied for awakening nodes proactively to prepare for the approaching target. However, most existing efforts about proactive wake-up simply awaken all the neighbor nodes in the area, where the target is expected to arrive, without any differentiation. In fact, it is sometimes unnecessary to awaken all the neighbor nodes. To sleep-schedule nodes precisely, so as to reduce the energy consumption for proactive wake-up.

II. SYSTEM ANALYSIS

The existing system includes different routing metrics in Efficient QoS-aware GOR (EQGOR) algorithm for QoS provisioning in WSNs. EQGOR selects and prioritizes the forwarding candidate set in an efficient manner, which is suitable for WSNs in respect of energy efficiency, latency, and time complexity. EQGOR significantly improves both the end-to-end energy efficiency and latency, and it is characterized by the low time complexity. Mechanism to ensure the reliability is contributed, in which Backup nodes selection and forwarding algorithm is contributed to involve in forwarding process in the case of failure of the next hop which is selected based on the high energy nodes.

A tailored candidate selection and prioritization algorithm proposed in EQGOR for QoS provisioning in group WSNs. When source node is sending a data packet to the sink node, it selects and prioritizes forwarding candidates based on the scheme as proposed. Then it forwards the data packet to destination. Two adjustable parameters introduced, which represents the minimum and maximum number of candidates to be prioritized. EQGOR will only prioritize the first k available next-hop nodes based on the observation of the similar pare to principle in GOR. This research suffers from a limitation such as, energy consumption and latency.

The proposed system introduced Improved Efficient QoS aware Geographic Opportunistic Routing (IEQGOR) algorithm. It combines geographic routing, awake-asleep scheduling, and for achieving an energy-efficient data gathering mechanism. The main contributions of this paper are summarized as follows.

1) This paper is a pioneering work proposing and analyzing sleep scheduling algorithms for geographic routing in duty-cycled mobile WSNs, which take full advantages of both duty cycling and sensor mobility.

2) Specifically, this paper proposes sleep and awake method, which effectively extend existing geographic routing algorithms designed for dynamic WSNs into duty-cycled mobile WSNs by applying sleep scheduling. This requirement and geographic routing requirement to change the asleep or awake state of sensor nodes.

III. RELATED WORK

In this section, we briefly introduce the related work on geographic routing and sleep scheduling.

A. Geographic Routing

The basic idea of geographic routing is greedy routing. Specifically, each packet is tagged with the coordinates of its destination, all nodes know their own coordinates, and a node forward the packet to its neighbour that is geographically closest to the destination. The earliest proposal for geographic routing has a local minimum problem in that a node may have no closer neighbour to the destination. For this reason, face routing and its variants are proposed to use geometric rules (e.g., right hand rule) to route around voids near the local minimum in case it happens. However, these algorithms require converting the network into a planar graph or removing the problematic cross links from the network which are not very applicable in realistic conditions. Moreover, there is also a hole problem in geographic routing, in that a hole can be formed by a set of dead sensor nodes running out of energy or being damaged. To solve this problem, some research work try to identify the hole boundary nodes first and then use these boundary nodes to avoid the hole. Others try to use geometric modelling to find an optimized hole by passing routing path. Recently, by using a *step back and mark* strategy when it cannot find the next-hop node, which does not have the local minimum or the hole problem. However, all these works only consider WSNs with static nodes. They all try to achieve this goal by dynamically choosing the forwarding node based on the best potential node that can transmit packets. Specially, these protocols typically take into account such factors as link uncertainty to adapt routing accordingly. However, few of these works address the local minimum or hole problem, and nearly all these works do not consider the situation that sensor nodes can be mobile.

B. Sleep Scheduling

A sleep scheduling algorithm must be distributed, simple, scalable and energy efficient. In this thesis, the problem of designing such an algorithm which extends network lifetime while maintaining a target level of partial coverage is investigated. The basic mechanism for sleep scheduling is to select a subset of nodes to be awake in a given epoch while the remaining nodes are in the sleep state that minimizes power consumption, so that the overall energy consumption can be reduced. Existing works on sleep scheduling in WSNs mainly focus on two targets: *point coverage* and *node coverage*. For *point coverage* (also known as spatial coverage), the awake nodes in each epoch are chosen to cover every point of the deployed field. Existing *point coverage* oriented algorithms differ in their sleep scheduling goals: minimizing energy consumption, or minimizing average event detection latency. For *node coverage* (also called network coverage), awake nodes are selected to construct a globally connected network such that each asleep node is an immediate neighbour of at least one awake node. However, all these works generally focused on the medium access layer of static WSNs with static nodes. In this paper, the sleep scheduling designed for dynamic nodes in WSNs.

IV. MODULES

In this section, the proposed system consists of four modules: Geographic opportunistic routing, data transmission, sleep and awake method and performance analysis.

A. Geographic opportunistic routing

Geographic routing is a routing principle that relies on geographic position information. It is mainly used to identify the location of sink node and send message to the geographic location of destination instead of using the network address. Based on the idea, the source node finds its neighbour node location and maintain the table.

Candidate selection: The Candidate selection and prioritization algorithm in EQGOR for QoS provisioning in WSNs. When node is sending a data packet to the sink node, it selects and prioritizes forwarding candidates based on the EQGOR scheme. The minimum and maximum number of candidates to be prioritized. EQGOR will only prioritize the first k available next-hop nodes.

Path determination: After selecting the candidates the path has to be determined. Data packets are

forwarded to the destination through this established route.

B. Data Conveying

Data conveying is the physical transfer of data (A digital bit stream) over a point-to-point or point-to-multipoint channel. Data has to be conveyed on the route which is selected by the EQGOR protocol scheme

C. Sleep and Awake Method

Source, Destination and intermediaters are only in awake mode. Other nodes are go to a sleep mode.

D. Performanace Analysis

Finally, Performance has to be analysed between GPSR, EQGOR and IEQGOR protocols. The analysed result is shown with the help of graph. IEQGOR significantly improves the energy consumption, latency and transmission cost for the QoS provisioning in WSNs. IEQGOR shows obvious advantage over EQGOR.

V. SIMULATION

There are several network simulator are used to simulate the wireless sensor networks. NS2 is the one of the simulator software used for WSN [5]. It is an open source tool and used in complex scenario also easy to debug. So here NS2 is used. The performance of this routing method is analyzed based on three parameters: energy consumption, latency and packet delivery ratio. Finally the performance is analysed between GPSR, EQGOR and IEQGOR. Compared to EQGOR the energy efficiency has been increased and energy consumption, latency and time complexity has been reduced.

VI.PERFORMANCE EVALUATION

A] Evaluation Setup

To evaluate the performance of the proposed IEQGOR algorithms when applying geographic routing into duty-cycled
mobile WSNs, conduct extensive simulations. This compare the performance of the proposed IEQGOR algorithms with EQGOR and GOR, these are the only other sleep scheduling algorithms focusing on geographic routing in duty-cycled WSNs. The performance metric is the lengths of the transmission paths searched by geographic routing in duty-cycled WSNs employing IEQGOR as the length of geographic routing transmission path is widely used to estimate the transmission time, transmission delay, etc. In addition, the network lifetime of WSNs employing , dynamic based are also observed to check whether it degrades the network lifetime.

B] Evaluation Results

1) Static Sink with Mobile Sensor Nodes: Here the duty cycled for mobile sensor nodes with static sink can be explained. The sleep scheduling can be done with nodes that are not included as data transmission nodes. This can be used to save significant amount of energy by turning off the redundant nodes in the network.

2) Mobile Sink with Static Sensor Nodes:

Here the duty cycled can be done with static sensor and mobile sink. That is also due to that there are much more
awake nodes closest to sink in dynamic based WSNs, compared with that in static nodes based WSNs. And dynamic based WSNs and static based WSNs share the same criteria to choose the awake nodes closest to sink. Furthermore, the average network lifetime with a mobile sink is nearly the same as that in other WSNs with a mobile.

3) Mobile Sink With Mobile Sensor Nodes:

Here the duty cycled can be done with mobile sink and mobile sensor nodes. In duty-cycled mobile WSNs, from the view of sleep scheduling, do not require the geographic routing to change its original geographic forwarding mechanism, and they both consider the connected-k neighborhood requirement and geographic routing requirement to change the asleep or awake state of sensor nodes.

C] Performance Analysis

The performance parameters like PDR, latency and energy consumption are determined using NS2. Comparison graph was shown using nam window. Packet delivery ratio (PDR) defines the ratio of total number of packets that are delivered to the total number of packets that are sent. If the PDR is high means most of the packets are successfully delivered to base station. Packet drop can be defined as the difference between the packets sent and the packets received. Latency defines the time taken for a packet to reach the destination.

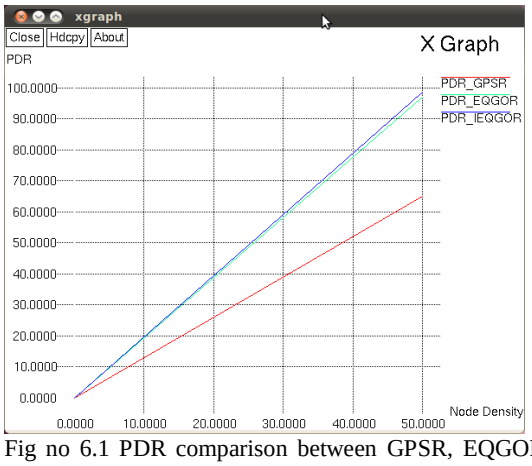

Fig no 6.1 PDR comparison between GPSR, EQGOR and IEQGOR

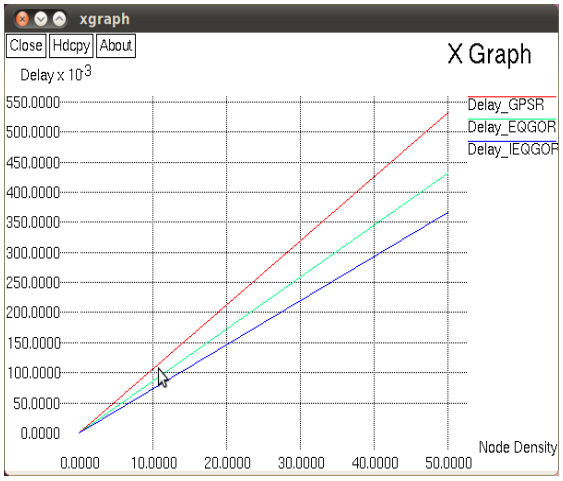

Fig no 6.2 Delay comparison between GPSR, EQGOR and IEQGOR

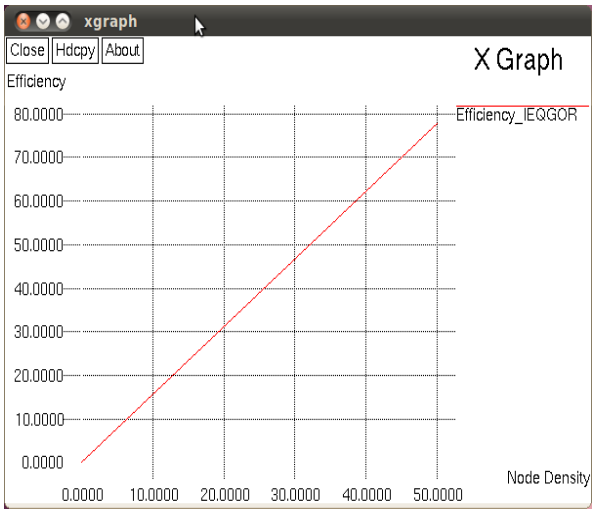

Fig no 6.3 Energy efficiency of nodes using IEQGOR

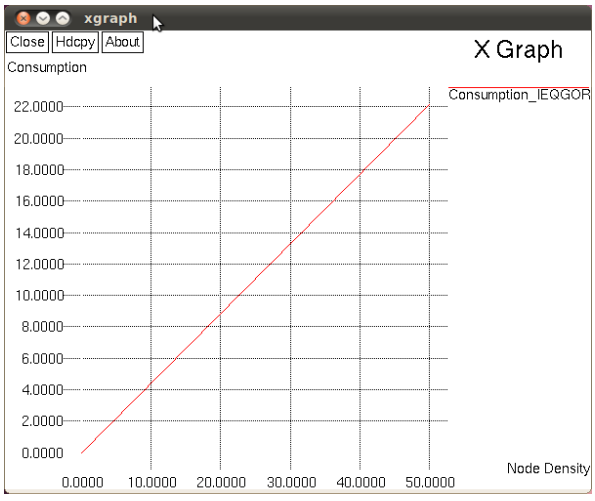

Fig no 6.4 Energy consumption of nodes using IEQGOR

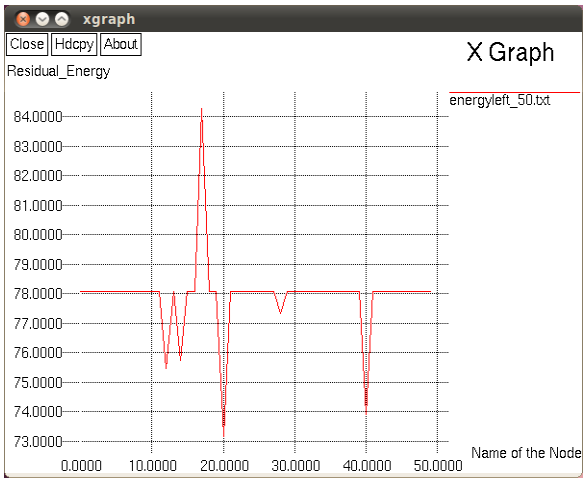

Fig no 6.5 Residual energy of nodes using IEQGOR

The proposed algorithm which uses location information to determine whether a node can sleep when the transmission range is larger than twice the sensing range. A node decides to sleep if every location within its coverage is already k-covered by other active nodes. Randomized back off times are used to avoid shutting down nodes at the same time. Hence the duty cycled dynamic nodes are sleep scheduled.

VII.CONCLUSIONS

The problem of efficient EQGOR has been studied for multi constrained QoS provisioning in WSNs. The proposed system aimed at providing unique sleep scheduling and awake method inorder to reduce energy consumptions and high overhead. They demonstrate that sleep and awake method are very effective in duty-cycled mobile WSNs compared with EQGOR algorithm. This work has shown that sleep scheduling is a worthy research direction to adapt geographic forwarding methods into duty-cycled mobile WSNs. Therefore, it is necessary to jointly consider synchronization and scheduling to improve the overall system performance. Evaluation results demonstrate its efficacy for QoS provisioning in WSNs.

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