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A Heuristic Method For Energy Hoarding In Wireless Sensor Networks

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Abstract: In the past few years, we have seen a fast expansion in the field of mobile computing due to the production of inexpensive, widely available wireless devices. In contrast, current devices applications and protocols in WSN are mainly focused on energy consumption and life time of network. To provide the required network functionality in WSN and to sustain network life time it process selective routing protocol. Most of the battery powers drain in data aggregation than processing and the network would affect in case of any particular node failure. To address this problem, the energy efficient Multi-sink path selection strategy is proposed, where each source node finds its sinks on its surroundings. If the destination is not reachable by its sink, each sink find its next sink and perform traffic through that sink. This paper presents the techniques in Multipath selection to enhance the lifetime of the sensors in WSN.

Keywords: Wireless sensor network, Multisink, Path selection strategy, Network life time

INTRODUCTION

A wireless sensor network is a collection of nodes organized into a cooperative network. Every node has its own processing capability, may contain multiple types of memory (program, data and flash memories), have a RF transceiver(usually with a single omni-directional antenna), have a power source (e.g., batteries and solar cells), that mainly accommodates numerous sensors and actuators .Such systems can revolutionize the way to live and work. Currently, wireless sensor networks are beginning to be deployed at an accelerated pace. This can be considered as the Internet becoming a physical network. This new skill is stimulating with unrestrained prospective for numerous application areas. Most current deployed sensor networks involve relatively small amount of sensors, wired to a central processing unit in which every signal processing is performed.

Wireless sensor networks are composed of a large number of sensor nodes deployed in a field. Each sensor nodes is equipped with battery with extremely limited processing capabilities. These wireless sensor networks are capable to maintain many new applications, including habitat monitoring [1] and agricultural monitoring [2]. In such wireless sensor networks (WSN), sensors send data packets to sink nodes through multi-hop wireless links. As the size of the network increases, the sensors near the sink nodes will dissipate energy faster than other sensors as they need to forward a larger number of messages, and prolonging the lifetime of whole network becomes a critical problem. Reducing energy utilization is the most important objective in the design of a sensor network. These constraints have led to intensive research efforts on designing energy-efficient protocols.

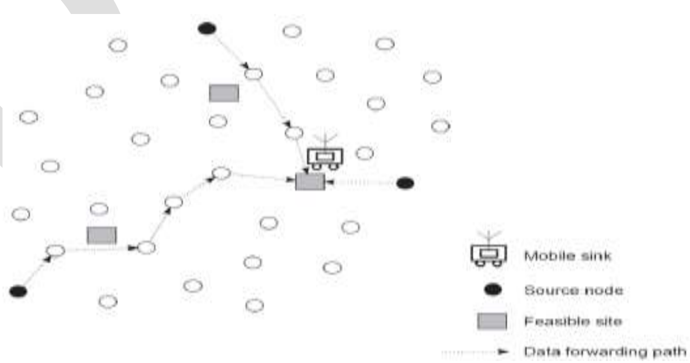

Fig 1: Mobile sink performing data collection in a WSN

RELATED WORK

Due to the battery resource constraint, it is a critical issue to save energy in wireless sensor networks, particularly in large sensor networks. Considering this issues many researches and surveys are made in wireless sensor network. In this section, we exhibit an overview of various works that examine the energy efficient routing protocols and also various methodologies for energy consumption for wireless sensor network along with its limits. Multi-constrained QoS multipath routing(MCMP) [3] is mainly designed to avoid probabilistic programming problem i.e. end –to –end and soft QoS problem. MCMP is developed according to linear programming approach and then to deterministic approximation to define end-to-end and soft QoS problems
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Energy Constrained Multipath Routing(ECMP) [4] is the extended version of MCMP to provide energy-efficient communication. ECMP introduces an energy optimization problem. Energy optimization problem is constrained by reliability, delay and geo-spatial energy consumption to provide multi-constrained QoS routing in sensor networks. Thus, ECMP satisfy delay and reliability requirement. Delay-Constrained High-Throughput Protocol for Multipath Transmission (DCHT) [5] is the modified version of Directed Diffusion that uses multipath routing approach to support high-quality video streaming in low-power wireless sensor networks. The protocol introduces a novel path reinforcement method and uses a new routing cost function that takes into account the expected transmission count (ETX) [6] and delay metrics to discover high-quality paths with minimum end-to end delay. The utilized path reinforcement strategy and routing metric in DCHT greatly improves the performance of the original Directed Diffusion by constructing multiple low-latency high-quality paths.

Energy-Efficient Multipath Routing Protocol [7] distributes the network traffic over the multiple node-disjoint paths. Whenever an event occurs, a sensor node in the event area is selected as the source node. The selected source node initiates the route discovery process and transmits multiple Route-request messages to its neighbouring nodes. Route-request messages include different path IDs to construct multiple node-disjoint paths from the selected source node towards the sink node. All the intermediate nodes select one of their best next-hop neighbouring nodes that are not included in any other paths during the route discovery process. Sink node upon reception of the first Route-request message, sets its timer to fulfil the path establishment process in an acceptable period. All the paths discovered after the timer timeouts are considered as low-quality paths and the Route-request messages received from these paths are discarded by the sink node. Then, the sink node assigns different data rates to the established paths.

SYSTEM ARCHITECTURE

Several studies have demonstrated the benefits of using a mobile sink to reduce the energy consumption of nodes and to prevent the formation of energy holes in wireless sensor networks (WSNs). However, these benefits are dependent on the path taken by the mobile sink, mainly in delay-sensitive applications, as all sensed data must be composed within a given time constraint. An approach projected to address this challenge is to form a hybrid moving pattern in which a mobile-sink node only visits rendezvous points (RPs), as opposed to all nodes. Sensor nodes that are not RPs forward their sensed data via multi hopping to the nearest RP. The essential problem then becomes computing a tour that visits all these RPs within a given delay bound. Determining the optimal tour, however, is an NP-hard problem. To deal with this problem, a methodology called weighted rendezvous planning (WRP) is proposed, whereby every sensor node is assigned a weight corresponding to its hop distance from the tour and the number of data packets that it forwards to the closest RP.

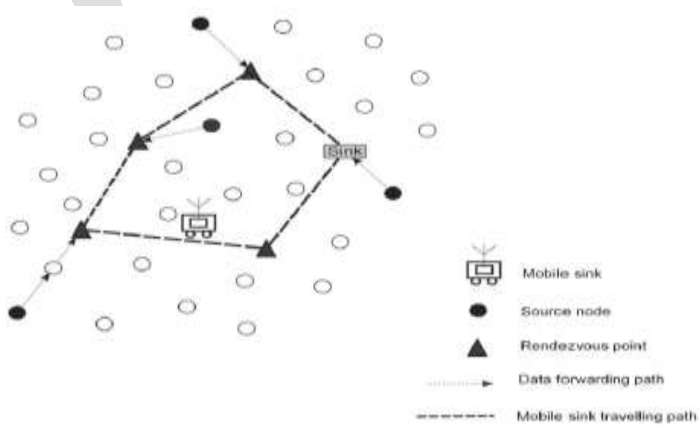

Fig 2: Hybrid movement pattern for a mobile sink node.

In WSNs with a mobile sink, one fundamental problem is to determine how the mobile sink goes about collecting sensed data. One approach is to visit each sensor node to receive sensed data directly. This is essentially the well-known traveling salesman problem (TSP), where the goal is to find the shortest tour that visits all sensor nodes. To this end, researchers have proposed the use of rendezvous points (RPs) to bound the tour length. This means a subset of sensor nodes are designated as RPs, and non-RP nodes simply forward their data to RPs. A tour is then computed for the set of RPs, as shown in Fig 2. As a result, the problem, which is called rendezvous design, becomes selecting the most suitable RPs that minimize energy consumption in multihop communications while meeting a given packet delivery bound. A secondary problem here is to select the set of RPs that result in uniform energy expenditure among sensor nodes to maximize network lifetime. A DEETP is an NP hard problem and propose a heuristic method, which is called weighted rendezvous planning (WRP), to determine the tour of a mobile-sink node. In WRP, the sensor nodes with more connections to other nodes and placed farther from the computed tour in terms of hop count are given a higher priority.In order to design the routing algorithm the following node models are considered.In large density applications, the sensor node should be transmits the sensed data to mobile sink within time constraint. The proposed system the cluster head transmits to Rendezvous point rather than all sensor nodes. Due to Processing overhead of Rendezvous point is not appropriate for large and delay sensitive applications. To overcome this problem, the proposed method is a heuristic method for energy hoarding in wireless sensor networks. The sensor nodes are organized into clusters. Within a cluster, nodes transmit data to cluster head (CH) through routing protocol. In the clustering process, Cluster Head is elected for each cluster .CH have a responsibilities for collecting data from each sensor node and transmits data to nearest Rendezvous point. High energy first (HEF) clustering algorithm is used for selecting cluster head with high ranking of residual energy of each sensor node. This algorithm is used for minimizes the energy depletion throughout sensor network field. The travelling Path of the Mobile Sink to visit all Rendezvous point which can be considered as a NP Hard problem. This problem taken as delay-aware energy efficient path (DEETP) and solved as Weighted Rendezvous Planning (WRP) algorithm. WRP algorithm calculating weight for each sensor node which can be computed by hop distance and number of packets forwarded.

ASSUMPTIONS

The assumptions that are made during this work are.

1) The communication time between the sink and sensor nodes is negligible, as compared with the sink node's traveling time. Similarly, the delay due to multihop communications including transmission, propagation, and queuing delays is negligible with respect to the traveling time of the mobile sink in a given round.
2) Each RP node has sufficient storage to buffer all sensed data.
3) The sojourn time of the mobile sink at each RP is sufficient to drain all stored data.
4) The mobile sink is aware of the location of each RP.
5) All nodes are connected, and there are no isolated sensor nodes.
6) Sensor nodes have a fixed data transmission range.
7) Each sensor node produces one data packet with the length of b bits in time interval D.

SIMULATION RESULTS

The simulation results and performance comparison of the mobile node and multipoint sink routing protocols is analyzed. Important parameters are compared with single mobile node and Multisink mobile nodes such as energy consumption and throughput. When mobile node fails to transmit data the communication established is difficult. But in the case of Multisink point no node fails to communicate and transmits the data without network overheads. Comparing to existing method the traffic size and network overheads of Multisink point is low.

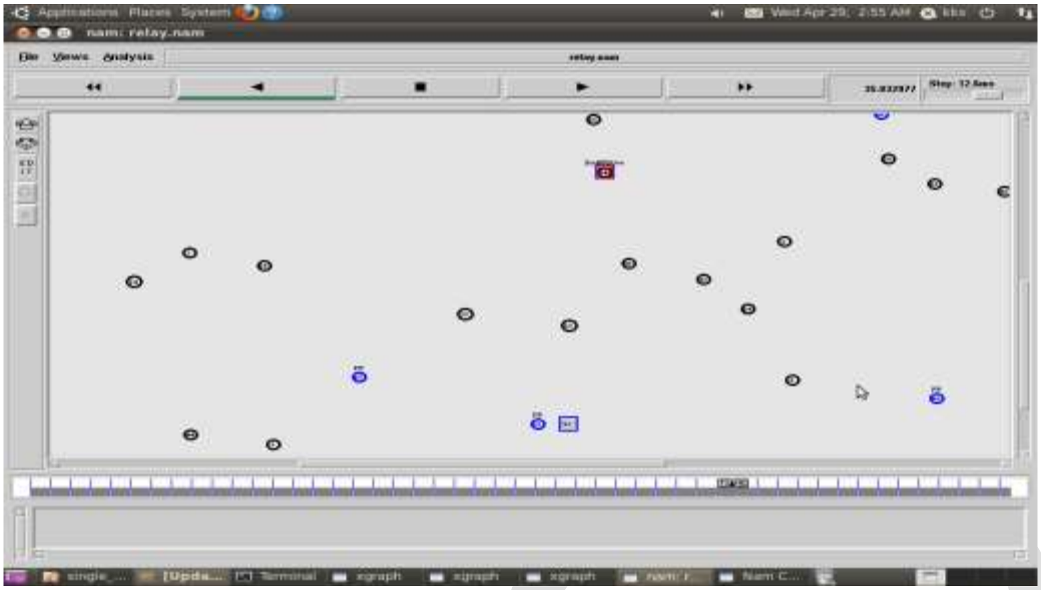

Fig 3: A WSN consisting of base station and a single mobile sink node using WRP algorithm

Figure 3 shows a single mobile sink collecting data from each Rendezvous Point and relaying back to the base station using WRP algorithm for computing the path to cover the RPs in shortest time possible.

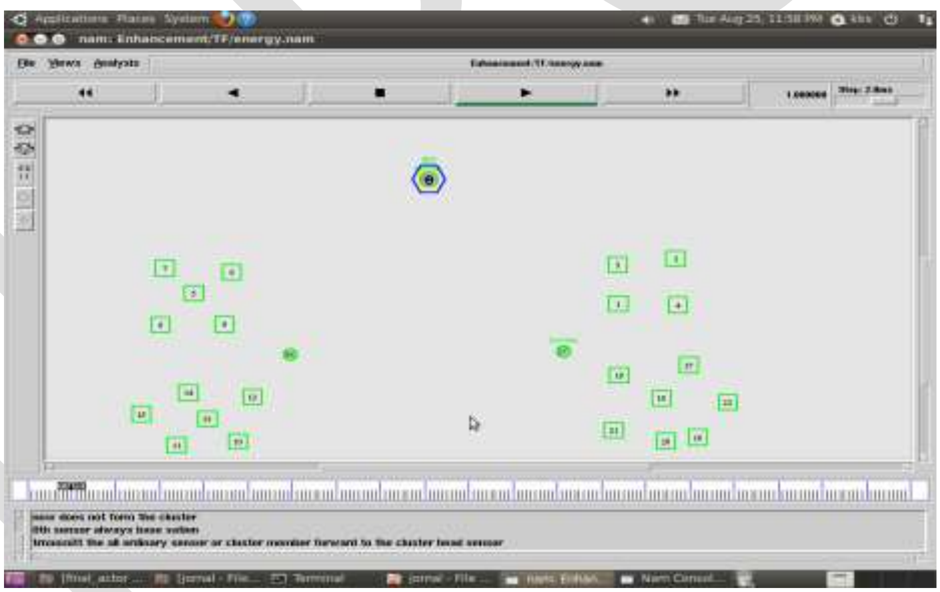

Fig 4: Sensor nodes are arranged into clusters for maximum accessibility for the multisink mobile nodes

The sensor nodes are arranged into clusters in order to prolong network lifetime and for maximum conservation of energy.Multiple sink nodes are used.This is useful in case a mobile sink runs out of energy.WRP maps out a route for the mobile sinks to collect the data from RPs; here the RPs are represented by Gateway as shown in Figure 4.

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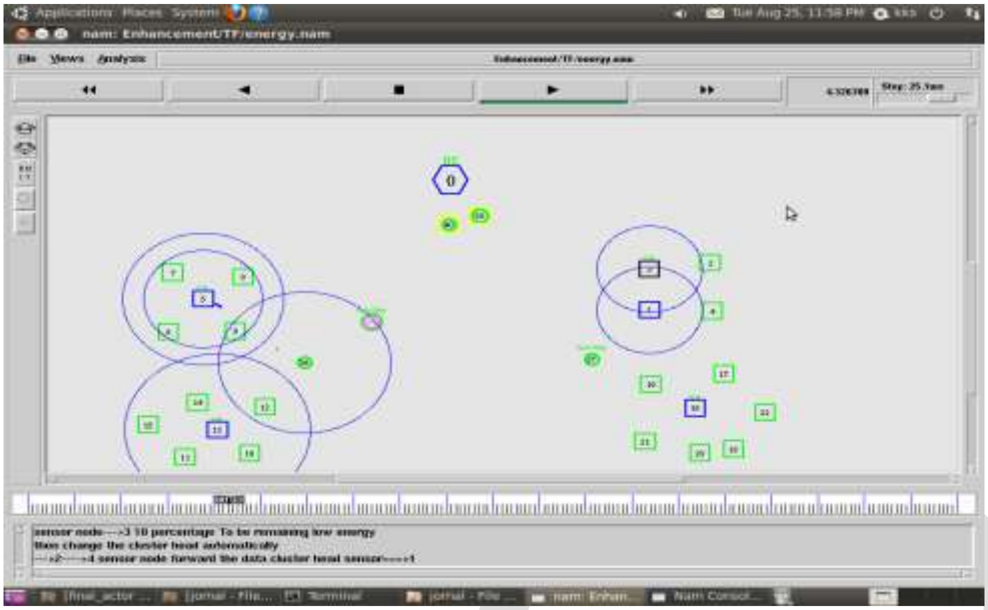

Fig 5: Multisink mobile nodes collect data from each cluster via gateway

The blue coloured nodes show the cluster heads(CH) in each cluster in Figure 5. They are selected by the High Energy First Clustering algorithm. This selects the node having highest energy to be the CH. When the CH gets depleted of energy, a new cluster head is selected. The energy-depleted CH is represented by the black coloured nodes.CH accumulates the data from their respective cluster and transmits to the visiting mobile sink nodes who in turn relays the data to the base station.Mobile sinks are yellow coloured in the figure.

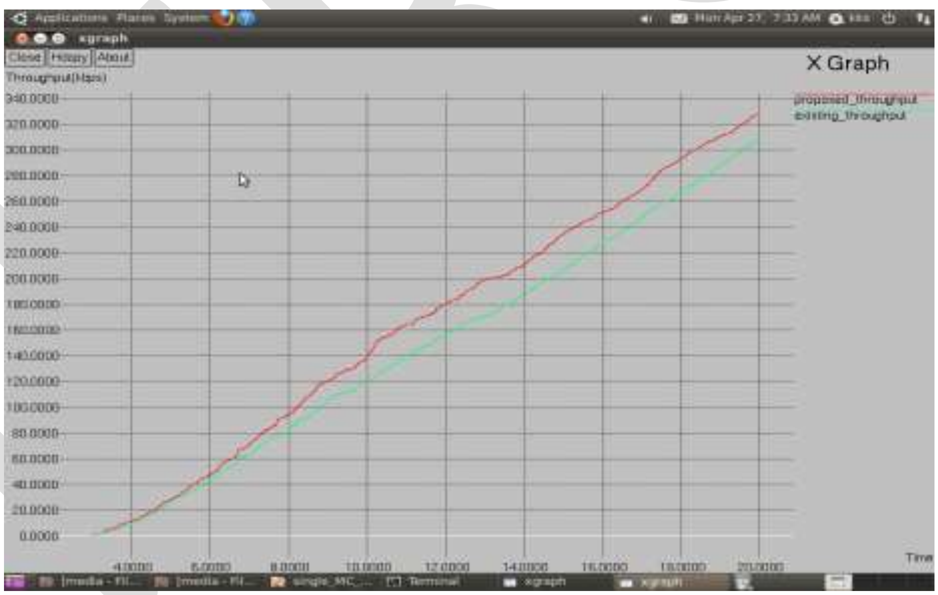

Fig 6: Throughput comparison

Figure 6 shows the throughput comparison when WRP is used. Throughput increases significantly when mobile sinks using WRP is used.

CONCLUSION

In this paper WRP, which is a novel algorithm for controlling the movement of a mobile sink in a WSN. WRP selects the set of RPs such that the energy expenditure of sensor nodes is minimized and uniform to prevent the formation of energy holes while ensuring sensed data are collected on time. The proposed method is a heuristic method for energy hoarding in wireless sensor networks. The sensor nodes are organized into clusters. Within a cluster, nodes transmit data to cluster head (CH) through routing protocol. Clustering algorithm is to choose the highest-ranking residue energy of sensor as a cluster head. This algorithm is used for minimizing energy depletion and maximizing the network lifetime. A mobile sink that preferentially visits areas of RP will prevent energy holes from forming in a WSN.These Multisink nodes and path selection strategy techniques are used for reliable communication and also to prolong the network lifetime.

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