Implementation of Network Coding and Duty Cycle for Energy Consumption in WSN

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Abstract— **Mobile sink minimizing the utilization of energy resource of nodes and prevents the formation of energy holes in wireless sensor networks(WSNs).These advantages are based on the path chosen by the mobile sink, especially in delay-sensitive applications, as all data from sensing units must be collected within a given time constraint. So, a hybrid moving pattern is formed 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 fundamental problem is computing a tour that visits all these RPs within a given delay bound. Identifying the optimal tour, however, is an NP-hard problem. To solve this problem, a heuristic called weighted rendezvous planning (WRP) is proposed, where each 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. WRP is validated via extensive computer simulation, and our results demonstrate that WRP enables a mobile sink to retrieve all sensed data within a given deadline while conserving the energy expenditure of sensor nodes.WRP reduces energy consumption by 22% and increases network lifetime by 44%, as compared with existing algorithms. The energy consumption can be reduced and network lifetime can be increased further by using local routing. In the case when the traffic increases the packet delivery ratio decreases which affects network efficiency. The packet delivery ratio can be balanced by adding additional nodes which withstand the traffic and keep the network efficiently.**

Keywords— **Rendezvous points (RPs),Wireless sensor networks(WSNs),Weighted rendezvous planning(WRP).**

I. Introduction

In recent times, wireless sensor networks have drawn a lot of attention due to their broad application potentials. Sensor nodes in the network are characterized by severely constrained energy resources and communicational capabilities. Sensor networks aggravate the security and privacy problems because they make large volumes of information easily available through remote access. Hence, adversaries need not be physically present to maintain surveillance. Due to limited capabilities of sensor nodes which are storage, power and processing, providing security and privacy against these attacks are challenging issues to sensor networks. These security and privacy issues have led to breaches of applications in Wireless Sensor Networks in corporate organizations and homes among others. Wireless sensor networks are potentially one of the most important technologies of this century. Recent advancement in wireless communications and electronics has enabled the development of low-cost, low-power, multifunctional miniature devices for use in remote sensing applications. The combination of these factors has improved the viability of utilizing a sensor network consisting of a large number of intelligent sensors, enabling the collection, processing analysis and dissemination of valuable information gathered in a variety of environments. They have wide-ranging applications, some of which include military environment monitoring, griculture. In addition, it is equipped with a battery, which may be difficult or impractical to replace, given the number of sensor nodes and deployed environment. These constraints have led to intensive research efforts on designing energy-efficient protocols.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. However, with an increasing number of nodes, this problem becomes intractable and impractical as the resulting tour length is likely to violate the delay bound of applications. 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 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. In this paper, we call this problem the delay-aware energyefficient path (DEETP). We show that the DEETP is an NPhard 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. We define the problem of finding a set of RPs to be visited by a mobile sink. The objective is to minimize energy consumption by reducing multihop transmissions from sensor nodes to RPs.

II. LITERATURE REVIEW

A. Rendezvous Planning in Wireless Sensor Networks with Mobile Elements

An energy saving can be achieved in wireless sensor networks by using mobile elements (MEs) capable of carrying data mechanically. The low movement speed of MEs hinders their use in data-intensive sensing applications with temporal constraints. To address this issue, a rendezvous-based approach in which a subset of nodes serves as the rendezvous points (RPs) that buffer data originated from sources and transfer to MEs when they arrive. RPs allow MEs to collect a large volume of data at a time without travelling long distances, which can achieve a necessary balance between network energy saving and data collection delay.

G. Xing at el (2008) formulates the minimum-energy rendezvous planning (MERP) problem which aims to find a set of RPs that can be visited by MEs within a required delay while the network energy consumed in transmitting data from sources to RPs is minimized

- They develop two rendezvous planning algorithms: RP-CP and RP-UG. RP-CP catches the optimal RPs when MEs move along the data routing tree. RP-UG is a utility-based acquisitive heuristic that can find RPs with good ratios of network energy saving to ME travel distance
- They design the Rendezvous-based Data Collection (RDC) protocol that facilitates reliable data transfers at RPs by efficiently coordinating MEs' movement and data transmission/caching in the network
- The simulations based on realistic settings ofMica2 motes show that our approach significantly outperforms several other schemes in high-bandwidth data collection under temporal constraints.

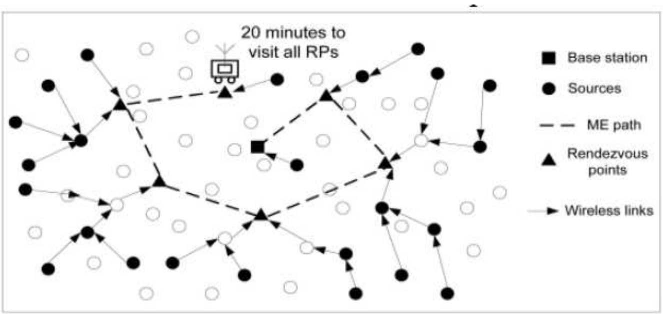

Fig.1 ME-based data collection

B. Efficient Data Collection in Wireless Sensor Networks with Path-Constrained Mobile Sinks

The sink mobility along a constrained path can improve the energy efficiency in wireless sensor networks. Due to the path constraint, a mobile sink with constant speed has limited communication time to collect data from the sensor nodes deployed arbitrarily. This poses significant challenges in jointly improving the amount of data collected and reducing the energy consumption. S. Gao at el (2011) proposed a novel data collection scheme, termed the Maximum Amount Shortest Path (MASP), that increases network throughput as well as conserves energy by optimizing the assignment of sensor nodes.

Path-Constrained Sink Mobility

Predictable sink mobility is exploited to improve energy efficiency of sensor networks. A mobile sink is fitted on a public transport vehicle which moves along a fixed path at times. However, all sensor nodes can only transfer data to the single mobile sink in one-hop mode. Actually, single-hop communication between all sensor nodes and the mobile sink may be infeasible due to the limits of existing road infrastructure and communication control. An architecture of wireless sensor networks with mobile sinks is proposed for a traffic investigation application. However, it is also assumed that all sensor nodes in MSSN are located within the direct communication range of the mobile sink.

Path-Controllable Sink Mobility

Most of the current work about path-controllable sink mobility has focused on how to design the optimal trajectories of mobile sinks to improve the network performance. Mobile element scheduling problem is studied, where the path of the mobile sink is optimized to visit each node and collect data before buffer overflows occur. The work is extended to support more complex scenario with multiple sinks.

C. *Maximizing the Lifetime of Wireless Sensor Networks with Mobile SinkiIn Delay-Tolerant Applications*

This paper proposes a framework to maximize the lifetime of the wireless sensor networks (WSNs) by using a mobile sink when the underlying applications tolerate delayed information delivery to the sink. Inside a prescribed delay tolerance level, each node does not need to throw the data immediately as it becomes available. Instead, the node can store the data for the time being and transmit it when the mobile sink is at the most favorable location for achieving the longest WSN lifetime. To find the best solution within the projected framework, optimization problems that maximize the lifetime of the WSN subject to the delay bound constraints, node energy constraints, and flow conservation constraints.

Y. Yun at el (2010) conducted extensive computational experiments on the optimization problems and find that the lifetime can be increased significantly as compared to not only the stationary sink model but also more traditional mobile sink models and also shown that the delay tolerance level does not affect the maximum lifetime of the WSN.

III. EXISTING SYSTEM

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. 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 3.1. 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. An 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.

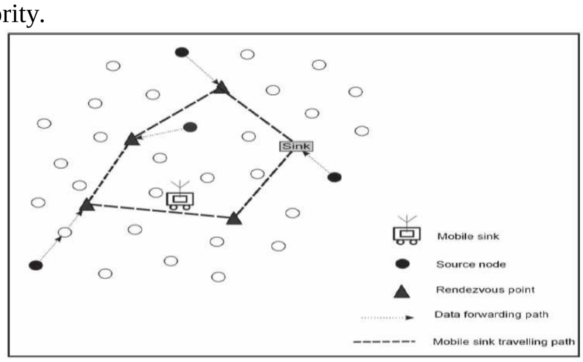

Fig.2 Hybrid movement pattern for a mobile sink node

Disadvantages

- Rendezvous points can collects the data from nodes directly instead of Cluster Head
- Mobile Sink's range or heavy involvement of network periphery nodes in data retrieval, processing, buffering, and delivering tasks
- These nodes run the risk of rapid energy exhaustion resulting in loss of network connectivity and decreased network lifetime.
- The specification of the appropriate number and locations of rendezvous Points (RPs) is crucial.
- The number of Rendezvous Points should be equivalent (neither small nor very large)to the deployment density of single nodes

IV. PROPOSED SYSTEM

We define the problem of finding a set of RPs to be visited by a mobile sink. The objective is to minimize energy consumption by reducing multi-hop transmissions from sensor nodes to RPs. This also limits the number of RPs such that the resulting tour does not exceed the required deadline of data packets.

- We propose WRP, which is a heuristic method that finds a near-optimal traveling tour that minimizes the energy consumption of sensor nodes. WRP assigns a weight to sensor nodes based on the number of data packets that they forward and hop distance from the tour, and selects the sensor nodes with the highest weight.
- We mathematically prove that selecting the sensor node that forwards the highest number of data packets and have the longest hop distance from the tour reduces the network energy consumption, as compared with other nodes. Moreover, we show that, in contrast to cluster-based (CB), rendezvous design for variable tracks (RD-VT), and rendezvous planning utility-based greedy (RP-UG) algorithms, WRP is guaranteed to find a tour if the latter exists.
- We demonstrate via computer simulation the properties and effectiveness of WRP against the CB, RD-VT, and RP-UG algorithms. Our results show that WRP achieves 14% more energy savings and 22% better distribution of energy consumption between sensor nodes than the said algorithms.

In the proposed system, Estimation of upper bounds of the network lifetime through bottleneck zone analysis in
(a) Random duty cycled WSN
(b) Non-duty cycled WSN using network coding in the bottleneck zone
(c) Random duty-cycled WSN using network coding in the bottleneck zone. The reason is that lifetime upper bounds allow on the design of sophisticated energy efficient protocols.

V. MODULE DESCRIPTION

➢ WSN creation and routing

In this module, a WSN is created. The sensor nodes and BS in configured and randomly deployed in the network area. The sensor nodes are equipped with energy resource. The sensor nodes are connected with wireless link. The sensor nodes will transmit the data to the Base station nodes. The sensor nodes need to consume the energy to send, receive the data. The communication is enabled in the network between sensor node and base station

➢ Analysis of Energy consumption in WSN

In this module, the Energy Consumption in the network is analysed. Based on the analysed results X-graphs are plotted. Throughput, delay, energy consumption are the basic parameters considered here and X-graphs are plotted for these parameters.

➢ Implementation of WRP method

In this module, WRP mechanism is implemented in the network. 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 WRP, the heuristic method that finds a near-optimal travelling tour that minimizes the energy consumption of sensor nodes. WRP assigns a weight to sensor nodes based on the number of data packets that they forward and hop distance from the tour, and selects the sensor nodes with the highest weight.

➢ Performance analysis

In this module, the performance of WRP is analysed. Based on the analysed results X-graphs are plotted. Throughput, delay, energy consumption are the basic parameters considered here and X-graphs are plotted for these parameters. Finally, the results obtained from this module is compared with third module results and comparison X-graphs are plotted. Form the comparison result, final RESULT is concluded.

➢ Enhancement Module:

In order to prevent the unwanted usage of energy in the sensor nodes, we implement Network coding and duty cycle technique.

- Network coding is a technique which allows the intermediate nodes to encode data packets received from its neighbouring nodes in a network.
- Network coding technique reduces the total number of transmissions in the network.
- Duty Cycle technique assigns each node with Sleep / Awake state.
- The nodes which are in idle state for a specific time will be put into sleep state to reduce the power consumption.

VI. RESULTS AND ANALYSIS

After implementing the proposed system on NS2 platform, the results obtained are as follows:

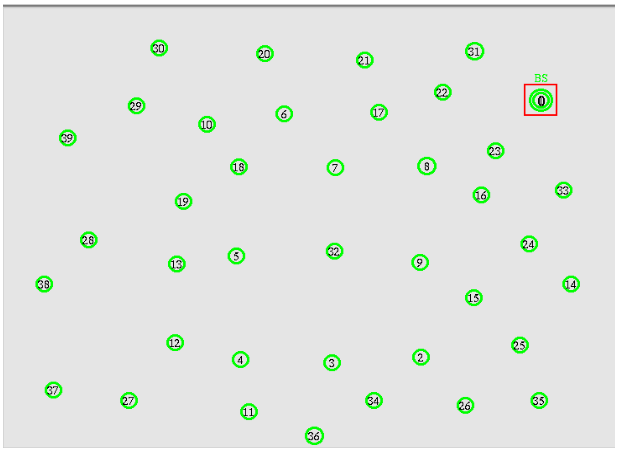

Fig. 3 Network Creation

The figure 3 shows the network creation stage of the system. Here the topology of the network is going to be seen. The Base Station (BS) is visible and it is going to phenom signal to other nodes.

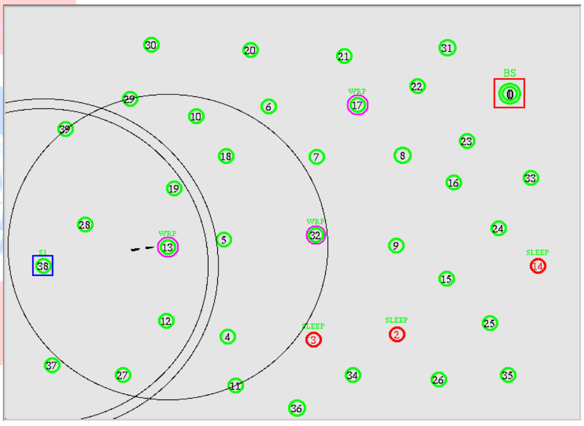

Fig. 4 Data Transmission

According to the proposed approach energy efficient path is going to be selected i.e. data is transmitted through WRP nodes.

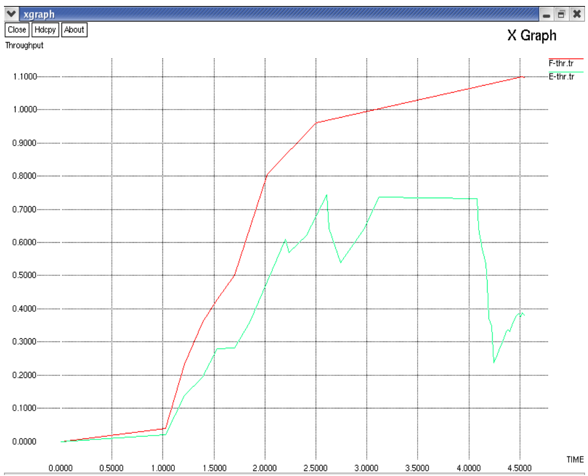

Fig.5 Throughput Comparison Graph

The figure 5 is showing the comparison graph of throughput between the existing system and proposed system. Throughput is high for proposed system.

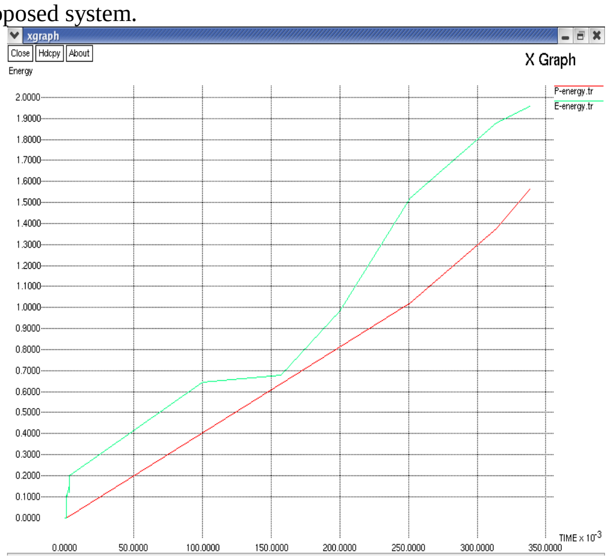

Fig. 6 Energy Consumption Comparison Graph

The figure 6 shows the energy consumption graph between existing system and proposed system. The energy consumption is less for proposed system as compared to existing system.

VII. CONCLUSIONS

In this paper, we have presented WRP, which is an ideal technique for managing the motion of a mobile sink in a WSN. The proposed method choose the group of RPs such that the utilization of energy of sensor nodes is reduced and unvarying to stop the formation of energy holes while making sure sensed data are collected on time. In addition, we have also extended WRP to use an SPT and an SMT. Apart from that, we have also considered visiting virtual nodes to take advantage of wireless coverage. And also with help of network coding and duty cycle it was possible to reduce energy consumption to the greater extent. Our results, which are obtained via computer simulation, indicate that WRP-SMT reduces the energy consumption of tested WSNs by 22% in comparison to CB. We also benchmarked WRP against existing schemes in terms of the difference between sensornode energy consumption. Our simulation results show that WRP uniformly distributes energy consumption by 39% and 44% better than CB and RD-VT, respectively.

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