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A new approach for reducing Rendezvous Point overhead in Wireless Sensor Networks

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***Abstract*—mobile sink used for data gathering from Rendezvous point in wireless sensor networks, so as to minimize the rendezvous point's overhead, energy utilization of nodes and to stop the energy holes formation in sensor network, and thereby prolong the wireless sensor network lifetime. These benefits can be reached based on the multiple mobile sink. All data that are sensed by sensor nodes must be collected and send to base station within the limited energy. An approach has been proposed in which multiple mobile sink node will visits the rendezvous points (RPs) and collect the data, where the rendezvous points will collect all neighbors' sensor nodes sensed data through multihop. A weighted rendezvous planning (WRP) algorithm used to fix the Rendezvous Point. The results demonstrate that weighted rendezvous planning enables multiple mobile sink to collect all sensed data within a given time while conserving the energy consumption of sensor nodes and minimize the overhead.**

***Keywords*— Rendezvous point; mobile sink; traffic; packet loss; lifetime; energy; weighted rendezvous planning.**

I. INTRODUCTION

A fundamental task of wireless sensor network is data gathering. Wireless sensor networks (WSN) usually composed of a large number of sensor nodes. Each sensor node has to the sense the data and sends that data to the sink via wireless transceiver in multihop manner. They are limited in computational and memory capacity. On the other hand, sensor nodes have limited energy resource, mostly battery powered. Therefore, energy efficient routing strategy is very important for network life span as well as performance improvement.

WSNs are considered for several critical applications including security, monitoring traffic, surveillance in battlefield, agriculture field and home automations. As these sensor nodes has constraint such as processing power, data storage and limited power supplies. Among number of challenges faced while designing WSNs and protocols, maximizing the sensor network lifetime is considered as critical impacts. When the sensed data is transferred to the sink in the multihop manner the energy in the sensor node is reduced.

The research on data dissemination in WSNs has recently an approach where some of the node is mobility in the network. The mobility nodes are referred as Mobile Sink [MS] roam about the sensing field and collect data from sensors. The author Shah et al. has introduced an approach in which the mobile node in the network field is used as the forwarding agent. The sensor nodes, which are in single hop communication with mobile node, will pass the data. The further investigation by Kim et al has proposed a data dissemination protocols in which tree like structure is built for communication and mobile sink access for tree. As in all works the mobile sink mobility is unpredictable.

The node nearby the sink is more responsible for collecting the data and sending those to the sink. In multihop communication, the sensor nodes that are nearby sink reduce its energy more than when compared with the node that is far away from the sink. More over the far away node from the sink maintains the 90% of their initial energy when compared with node that is near to the sink. This non-uniform depletion of nodes energy, results in partition of the network because of energy holes formation. The balancing sensor nodes energy consumption in order to prevent energy holes is an issue in wireless sensor networks.

When the mobile sink moves in random path, the MS cannot collect the data from sensor nodes in time in which it meet the delay in more sensitive data collection applications

II. RELATED WORK

Longer life span is important for such application of WSN. In energy conservation routing scheme, multi-hop communication achieves great success compared to single-hop communication. In multi-hop data routing process data routing load is non-uniformly distributed within the all nodes. Therefore, energy holes are created within the network. The energy hole degrades network performances as well as network life span.

Sink mobility scheme provides a significant landmark for network life span improvement. Sink mobility also distributes load uniformly among the nodes. Mobile sink is the movable sink. In sink mobility scheme, mobile sinks are moving into a specific path and collect data from static nodes and transmit to BS. The mobile sink moves in predefine or optimal path and collects data from static nodes. Recently, mobile sink mobility is the important consideration for performance improvement in wireless sensor networks.

Optimal path construction for sink movement is a challenging issue in sink mobility based scheme design. Shortest path tree (SPT) method used to find the shortest path for sink movement in WSN. Similarly, a MobilRoute routing protocol is proposed.

In these routing protocols, mobile sink movement path is forecasted in such way that all sensor nodes are required to be alert. The authors S. Gao, et al., propose a novel data collection scheme, known as maximum amount shortest path (MASP) scheme. In this scheme, two phase communication protocol has been designed to implement the MASP scheme. M. Marta and M. Cardei et al., a sink mobility scheme through pre-established mobility path and also propose a distributed algorithm for unrestricted mobility path constriction.

The 6-positions sink moment strategy and 12 - position sink movement strategy has been used for pre-established mobility path design. Depending on sink movement, Sink mobility can be classified into three categories: a) Random sink mobility, b) optimized sink mobility, and c) Fixed or Constrained sink mobility. In random sink movement trajectory, sink moves arbitrary direction and arbitrary speed. Therefore, these techniques are unable to distribute routing load uniformly. Therefore, random sink movement strategy cannot assure that the sink collects data within optimal time duration from static nodes. These techniques only reduce some traffic load among the nodes. In optimal sink mobility route, mobile sink can move through an optimal path.

The optimal movement path has been designed on the basis of particular network parameter. The path is continuously altered to ensure optimal network performance. In [20], mobile sink receives regular updates about the sensor nodes battery condition. According to battery condition of the sensor nodes, mobile sink select new position in such way that minimize the routing load on the nodes. Optimal path construction based sink movement scheme. The main drawback of the optimized sink mobility is huge message over head for every round update message collection. In fixed or constrained sink mobility scheme, sinks move through a predefine set of path segments inside the network field. The fixed route of the sink movement is used for avoiding presence obstacle in the monitoring environment. In monitoring environment, due to being there of obstacle it is very difficult to design random sink mobility scheme, and optimized sink mobility path. Therefore, predefined and fixed path has been designed for sink movement with respect to obstacle position. A CB algorithm is proposed, in which a binary search procedure is used to select RPs. In this scheme establish a path to their closest cluster head in terms of hop count. CB starts from the sink node's position and selects one node from each cluster as an RP, which is the closest node to the set of selected RPs.

In optimal mobility, loads are distributed more effectively compared to random mobility. The major drawback in optimal mobility scheme is large message overhead. In this paper, we propose random movement trajectory based on rendezvous point. Proposed scheme designs optimized path for multiple sinks movement in distributed manner. Scheme minimizes message overhead and data collection time.

III. WEIGHTED RENDEZVOUS PLANNING

This algorithm is used to select the Rendezvous Point (RP) [1]. The weight of sensor node *i* is calculated as

$$W_{max} = NFD(i) * H(i,M) \qquad (1)$$

Visiting the highest weighted node will reduce the number of multihop transmissions and thereby minimizes the energy consumption.

Algorithm shows how WRP is works. The algorithm shows how weight of sensor nodes calculates; the cost of the tour calculates and receives the data packets from the RP. It takes as input $G(V,E)$, and it outputs a set of RPs. WRP first adds the fixed sink node as the first RP. Then, it adds the highest weighted sensor node. After that, WRP calls TSP(·) to calculate the cost of the tour. If the tour length is less than the required length $l$max, the selected node from lines remains as an RP. Otherwise, t is removed from the tour. After a sensor node is added as an RP, WRP removes that RPs from the tour that no longer receives any data packets from sensor nodes. This is because adding a sensor node to the tour may reduce the number of data packets directed to this RPs. Consequently, this step affords WRP more opportunities to add other nodes into the tour.

IV. PROPOSED METHOD

To enhance an approach include data with different delay requirements. In large area, number of sensor nodes collecting data directly from nodes is impractical. The traveling path length increases when the sink visiting each sensor node. A mobile sink is required to visit some sensor nodes frequently and collect sensed data from RP. When the mobile sink does not reach the node, buffer size of node's data will overflow, so the energy holes, data loss and overhead occurs in RP.

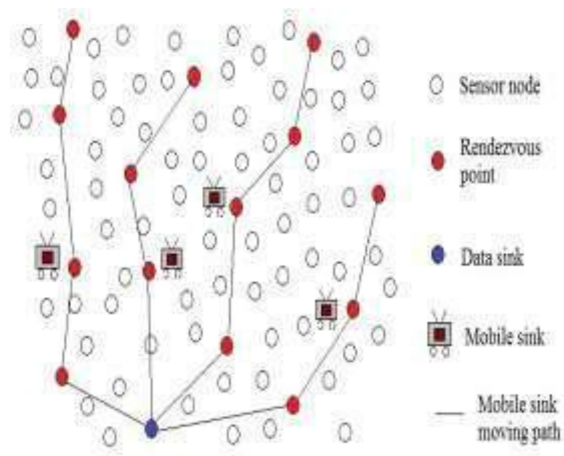

Fig.1. multiple sink data collection in the environmental field

To overcome this problem the rendezvous based framework has been proposed. In this framework the multiple mobile sink and a data sink introduced. RP selection is based on the WRP

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algorithm. RP fixed nearby the mobile sink path. There is no boundary for RP. Non RP nodes or sensor nodes send the sensed data to RP in multihop communication. The Mobile sink aware of each RP locations and thus the mobile sink will collect the data from RPs in short time period, before the buffer size overflow.

The overhead is measures by the number of control packets sent divided by the number of data packets successfully delivered. The mobile sink will collect the data and transfer to the data sink. The data sink will perform the aggregation and sends the data which is needed by the base station. The unwanted data is not transferred to the base station.

V. SIMULATION RESULTS

In the 250 x 250-m region the 300 sensor nodes are distributed randomly. The data sink is located at the bottom of the region. Each node in the field will sense the data and transfer to the rendezvous point through Multihop. Mobile sinks collect data from rendezvous points.
Table I

SIMULATION PARAMETERS

Parameters	Value
Field length	250 X 250
Number of nodes	50 to 300
Number of mobile sinks	4
Number of data sink	1
Transmission range	25m
Energy consumption	37.5mJ
Mobile sink speed	1m/s
Packet length(b)	30 bytes
Packet delay(D)	100 to 350 seconds
Battery capacity of Mobile sink	2200 E c (KJ)
Battery capacity of a sensor node	150J
Sensor's tx power consumption	0.06(J/Packet)
Sensor's rx power consumption	0.07(J/Packet)

We have the Mica2 Motes. Each sensor node generates one data packet every *T* time, which is then forwarded to an RP. We assume nodes are aware of the mobile sink's movement and, hence, arrival time. We record and compare the network energy consumption every *T* time. Moreover, there are a maximum of 300 sensor nodes, which is reasonable for most applications.

To measure network lifetime, we assume that all sensor nodes have a fully charged battery with 100 J of energy. The mobile sink's speed is 1 m/s. It visits each RP. Given a transmission range of 25 m, which is feasible for Mica2 or TelosB nodes, the mobile sink will be in a sensor node's transmission range for 20 s. Assuming a data transmission rate of 40 Kb/s, each sensor node will be able to send 3413 data packets with a length of 30 b to the mobile sink in 20 s. This means that the mobile sink has sufficient time to drain the buffer of all sensor nodes even when there are 300 sensor nodes.

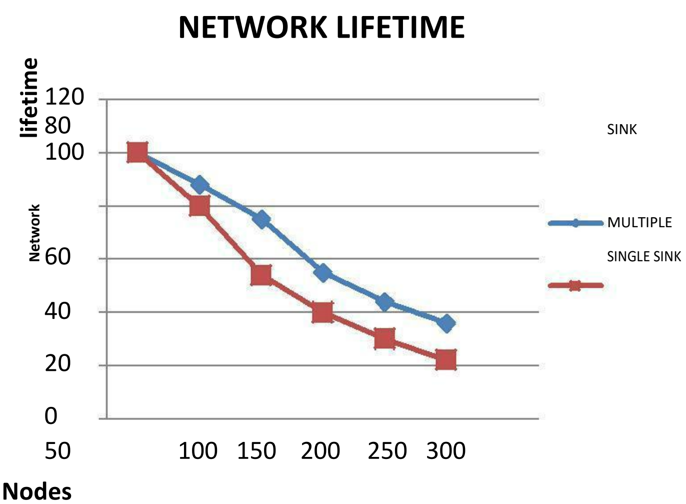

Fig 2: Network Lifetime for Multiple Sink and Single Sink

The fig shows that multiple sink improves the lifetime of the sensor network by 40% as compared with single sink. Lifetime of the network is more when using multiple sink because the single sink creates the energy holes are formed around the rendezvous point and create the overhead.

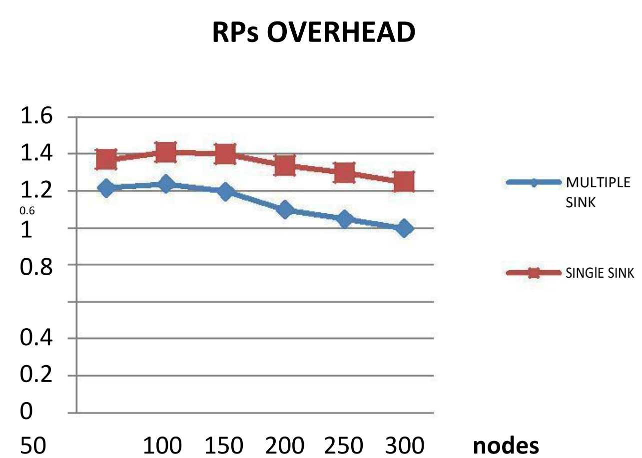

Fig 3: Overhead for multiple sink and single sink

Overhead measures by the total number of control packets sent divided by the number of data packets delivered successfully.

It is observed that about 33% of more packets are transmitted in using single sink compared to using multiple sink due to the participations of large number of nodes in the network.

VI. CONCLUSION

In this paper we have presented a framework in which the sensed data from the sensor nodes are collected in time from the rendezvous points by the multiple sinks and thus formation of energy holes in the network has been prevented. The mobile sink will transfer there collected data to the data sink which is responsible for aggregating and sending the data which is necessary for the base station. In time the data are collected from nodes and thus energy consumption has been reduced. With multiple mobile sink the data are gathered in short delay and thus data was not missed in the network. This approach is very useful in delay sensitive and large network applications. Thus the proposed system has increased the lifetime of the sensor network by reduce the overhead with lesser energy consumption.

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