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Fast and Dynamic Data Collection in Wireless Sensor Network Using Mobile Sinks

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ABSTRACT*:* In a wireless sensor network (WSN), the batteries of the nodes near the sink exhaust faster than other nodes due to the data traffic concentrating towards the sink node, leaving it stranded and disrupting the sensor data reporting. In order to alleviate this obstacle, mobile sinks (MS) are proposed in WSNs. MS implicitly provide load-balanced data delivery and achieve standardized energy consumption across the network. Conversely, advertising the position of the mobile sink to the whole network introduces an overhead in terms of energy consumption and packet delays. In this proposal, we propose MMS Routing, a novel, distributed, energy-efficient multiple mobile sink routing protocol, suitable for heterogeneous networks, which aims to minimize this overhead while preserving the advantages of mobile sinks by using multiple mobile sinks. To improve the data collection in energy constrained networks, the system proposes multiple mobile sink ability. In this proposal, a novel scheme called DDC (Dynamic Data Collection**)** with Distributed MMS (Multiple Mobile Sink). Unlike the existing solution, which improves content delivery by employing multiple mobile sinks and by deploying fine scheduling at strategically important points in the sensor environment, the proposed scheme does not allow packet drop at such situation. The experiments' and results shows that the proposal achieved uniform energy consumption and thereby extending the network lifetime.

KEYWORDS: Wireless sensor networks, Data collection, mobile sink, Grid, Scheduling,

I. INTRODUCTION

Effective data collection in wireless sensor network is a trivial task in order to perform the above a novel scheme called **GR** a Grid Routing with several mobile sinks is proposed. Unlike the existing approaches, this improves data delivery performance by employing several mobile sinks and by deploying fine scheduling at strategically important points in the sensor field, the proposed scheme does not allow packet drop at such situation. It aims to optimize the trade-off between nodes energy consumption and data delivery.

This chapter proposed a detailed description of the GR scheme which includes the procedure of constructing the virtual infrastructure and maintaining fresh routes towards the latest location of the mobile sink. A virtual infrastructure developed by partitioning the sensor field into a virtual grid of uniform sized cells where the total number of cells is a function of the number of sensor nodes. This includes the scheduling process and communication among cell headers over the sensor grid. A set of nodes close to centre of the cells are appointed as cluster headers which are responsible for keeping track of the latest location of the mobile sink and relieve the rest of member nodes from taking

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part in routes re-adjustment. Nodes other than the cluster headers associate themselves with the closest cluster headers and report the observed data to their cluster heads. Adjacent cluster headers communicate with each other via gateway nodes. The set of cluster headers nodes together with the gateway nodes constructs the virtual backbone structure. Before describing the methodology of GR scheme, it is worthwhile to highlight the various statements of the sensor networks. In WSN Nodes are randomly deployed and throughout remain static and All the nodes are of homogeneous architecture and know their location information. Some nodes adapt their transmission power based on the distance to the destination nodes. The mobile sink does not have any resources constraints and it performs periodic data collection from sensor nodes while moving along the periphery of the sensor field and maintains communication with the closest border-line cluster heads for data collection.

To address the above problem, a new method called weighted Grid Routing (GR) is proposed, whereby each sensor node is assigned in a grid corresponding to its hop distance from the tour and the number of data packets that it forwards to the closest RP. GR is validated via extensive computer simulation that enables a mobile sink to retrieve all sensed data within a given deadline while conserving the energy expenditure of sensor nodes. The use of GR, this helps 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, which is called rendezvous is designed for selecting the most suitable RPs that minimize energy consumption in multi-hop 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.

II. PROBLEM DEFINITION

Sensor networks offer opportunities to observe/interact with physical world aiding in gathering of data that was till recently difficult, expensive, or even impossible to collect. Sensor network deployments make sense practically only if run unattended for many months/years. Among wireless sensor node performances, radio transmissions are the most expensive in consuming energy. 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. In multi-hop infrastructure, Sensor nodes that are near a sink tend to become congested as they are responsible for forwarding data from nodes that are farther away.

This is essentially the well-known traveling salesman problem (TSP) [2], where the goal is to find the shortest tour that visits all sensor nodes. Though, with an increasing number of sensor nodes in sensory fields, this problem becomes difficult and unfeasible as the resulting tour length is likely to violate the delay bound of applications. Consider a WSN in which sensor nodes generate data packets periodically. Each data packet must be delivered to the sink node within a given deadline. In that situation, there is a mobile sink that moves around a WSN to collect data from a set of cell headers. The objective is to determine the set of CHs and associated tour that visits these CHs within the maximum allowed packet delay. The fundamental problem then becomes computing a tour that visits all these CHs within a given delay bound. This may result in data loss and improper data collection.

Existing techniques [3][4][5] failed to perform data collection with different delay requirements. This means a mobile sink is required to visit some sensor nodes or parts of a WSN more frequently than others, while ensuring that energy usage is minimized, and all data are collected within a given deadline. There is a need to extend WRP [3] to the multiple mobile sinks/rovers case in order to improve the scalability. While extending number of mobile sinks, it may involve with many sub problems such as interference and coordination between Mobile sinks. This theme was not applied in the existing work.

III. PROPOSED SYSTEM

To overcome the above stated problems, we proposed, a novel scheme called Distributed MMS (Multiple Mobile Sink) algorithm, which handles the communication and data collection scheduling process among multi mobile sink. Unlike the existing solutions, which improve data delivery performance by employing multiple mobile sinks and by deploying fine scheduling at deliberately important points in the sensor area, the proposed scheme does not allow packet drop at such situation, this overcomes the data collection problems. It aims to optimize the trade-off between nodes energy consumption and data delivery. Mobile sinks implicitly provide load balancing without extra effort. The

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hotspots around the sink change as per the sensor node mobility, and the increased energy drainage around the sink is spread through the network which helps in achieving uniform energy consumption and thereby extending the network lifetime. The proposed DMMS provides a grid based data collection with multiple mobile sink implementation, whereby each sensor node is assigned in a grid corresponding to its hop distance from the tour and the number of data packets that it forwards to the closest CH. And each CH finds the load and position of mobile sinks and re distributes to other CHs. DDC is validated via extensive computer simulation that enables a mobile sink to retrieve all sensed data within a given deadline while conserving the energy expenditure of sensor nodes. The use of cell headers (CHs) to bound the tour length. This means a subset of sensor nodes are designated as CHs and non-CH nodes simply forward their data to CHs. A tour is then computed for the set of CHs, which is called Cell headers is designed for selecting the most suitable representative that minimize energy consumption in multi-hop communications while meeting a given packet delivery bound. A secondary problem here is to select the set of CHs that result in uniform energy expenditure among sensor nodes to maximize network lifetime. Our proposed system designed to minimize energy consumption by reducing multihop transmissions from sensor nodes to CHs. This helps to find the sensor node that forwards the highest number of data packets and have the more resources as cell headers and it reduces the network energy consumption. Finally our system achieves 56% more energy savings and 67% better distribution of energy consumption between sensor nodes.

- **Scheduling**

The customized time window synchronization process performs customized scheduling for every sensor node in the sensor network. The scheme utilizes initiated time and customized time to collect data from the sensor node. The following steps represent the process of customized time synchronization.

```
1 begin
2   recognize node Ni…Nn
3         time_stamp of Ni
4      collected value from superior node of Ni
5   set time stamp Nt  for N1,N2…Nn
6      if  Nt  already set
7          Update (Nt );
8    Else do 5
9 for every node N. collect time and position details and
       Update_data update (Nt , time)
Collected data Dt=Dg(t) .., Dg(t+1)
10   verify the synchronization and find nearest Mobile sink Ms
11   if ( Ms found) then
12       update
13else
14      Trace (MS det) and declare Ni=0
15 if  (ni=0) then
17       braodcast ni to all CH
18else
19       end
20 send Ni(data-- MS)
21end
```

The above algorithm describes the basic scheduling process of proposed system.

A. DDC:

Distance calculation of nodes in the network:

This process calculates distance between each node using the distance based algorithm. The *distance-based* algorithm uses absolute point-to-point distance estimates (range) or angle estimates in location calculation.

Distance (d)=dis(x1 y1 x2 y2) (1)

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Where x1 is the x position of node1, y1 is the y position of node1, x2 is the x position of node2, y2 is the y position of node2. From the above function (1) the distance calculation parameter has been identified. The following formula is the detailed calculation of distance function.

distance [expr int(sqrt(pow(($x2-$x1),2)+pow(($y2-$y1),2)))] (2)

Here, the distance value stored in variable d. based on the distance the mobile sink will be selected by each CHs. Hence, distance-based methods require the additional equipment but through that we can reach much better resolution than in case of range-free ones.

Coordinates calculation for localization process:

In this process the results of the inter node distance calculation is used. The calculated distances are converted into geographic coordinates of network nodes. Different less and more complicated techniques may be used to perform calculations. The coordinates of nodes can be calculated using: geometrical techniques. The MSS is adopted to improve the accuracy of calculated estimates. This algorithm will check the calculated coordinates and distances to improve the accuracy of location and optimize the coordinates and distances. And, this transmits the position and distance details to the nearest CHs.

Deploy the Mobile sensor nodes in the estimated position:

In this process finally the Mobile sinks will be deployed in the estimated locations periodically. This helps to achieve the better optimized or accurate locations for the sensor nodes. Periodically the movement of the mobile sink will be scheduled.

Final Scheduling process:

In order to handle with dynamic network topology in wireless sensor network, this is generally caused by sink mobility. In those mobile environment every node need to setup their data delivery routes in accordance with the latest location of the mobile sink.

Mobile the sinks should reveal the most recent location to the entire sensor field. Using the DDC scheme, only the set of cell-headers that constitute the virtual backbone structure are responsible for maintaining fresh routes to the latest location of mobile sink and this communicates with multiple mobile sinks. For periodic data collection from the CH, the mobile sink moves around the sensor grid field and collects data via the closest border-line cell-header. The closest cell header upon discovering the sink's presence, shares this information with the rest of the cell headers in a controlled manner.

IV. RESULTS

Our system simulated using NS2 simulation tool. To evaluate the performance of the techniques, the system has developed a NS2-based simulation environment. The chapter shows the comparison study of DMSS against three methods that have the same objective as DMSS, namely WRP, CB, RD-VT, and RP-UG, using a custom simulator written in C++. This considers a connected WSN where nodes are placed uniformly on a sensor field with virtual grid environment. This note that interconnecting disconnected sensor nodes using a mobile node is a well-known and separate problem. The DDC can be also made to interconnect disconnected nodes if the required delivery time for data packets is greater than the shortest travelling tour to visit all sensor nodes. The reason that we have assumed uniform sensor-node distribution is because energy holes are more likely to form when nodes are distributed uniformly. The proposed design is implemented using NS-2 and it is analysed by considering certain parameters like Packet lost, Packet delivery ratio, Energy consumption and End- to-end delay. In the proposed DDC protocol selects the stable path to reduce the fake position and Packet lost and there by increases the packet delivery ratio and energy consumption. Programs in *NS-2* are scripted in OTcl and results of simulations can be visualized using the Network Animator (NAM) and Xgraph.

The simulation is carried out within the Network Simulator 2. In Linux operating system with Ubuntu as the interface tool. The mobility model uses the random waypoint model. There are 50 nodes defined in a simulation area of size 1000m x1000m. The mobility of nodes is limited to 5ms. The traffic model chosen is Constant Bit Rate (CBR) connections with packet size of 1000 bytes to emulate traffic over the network. Each packet starts from a random location to a random destination with a randomly chosen speed. Once the destination is reached, another random destination is targeted after a pause. The pause time, which affects the relative speeds of the mobiles, is varied.

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Parameter name	Parameter value
Stimulation tool	NS2
Antenna	Omni antenna
Channel	Wireless
Number of Mobile Sinks	3
Number of Mobile nodes	100
Communication agent	TCP
MAC type	802-11
LL	Link layer type

Table.1.0 Stimulation Parameters

Two sets of experiments are conducted. The simulation parameters for the sensor network are described in table 1.0. The average time elapsed for delivering a data packet within a successful transmission from source to destination. In order to evaluate the performance of GR, extensive simulations are conducted using the Ns2. In this chapter, the scenario and the parameters used for the simulations, results and the comparative performance evaluation of GR are presented. Energy is the most important resource in WSNs since sensor nodes' capabilities are sustained until their batteries are exhausted. Performance of a WSN is directly related to its lifetime. In GR it defines lifetime as the time until a sensor node in the network dies due to the exhaustion of its battery. This chapter measures the energy consumption of each node in the experiments. Sensor nodes consume energy at different rates during transmission, idle, moving, waiting , reception ,sleeping, which are calculated in the experiments.

PACKET DELIVERY RATIO

The ratio between the, number of received data packets to the number of total data packets sent by the source.

$$\text{Packet Delivery ratio} = \frac{\text{Number of packet received}}{\text{Numbers of packets send}} \times 100$$

In table 2.0, the proposed GR of packet delivery ratio is increased when compared with the existing protocols.

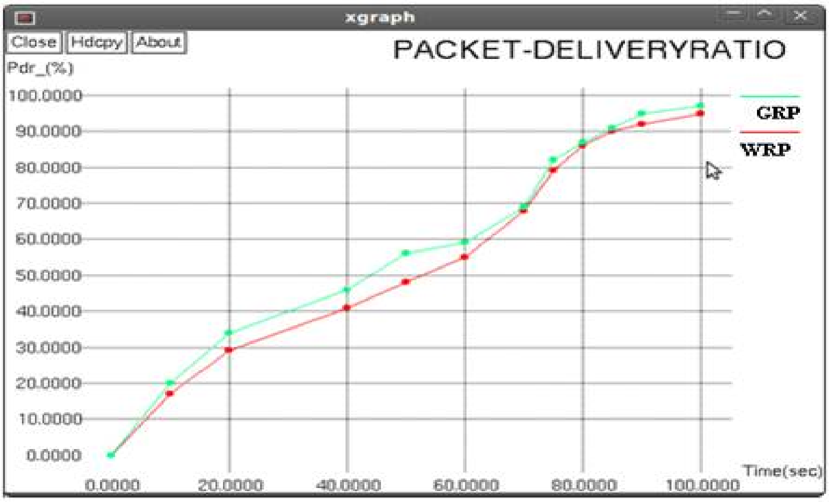

Fig.1.0. Packet Delivery Ratio chart and its table

As can be clearly seen in figure 1.0, the packet delivery ratio in GR is very much better when compared with WRP in all scenarios. The reason for the better packet delivery ratio in GR over WRP is that GR protocol tries to guarantee that the packets will be delivered to the mobile sink by delay compromising. If it is not possible for the

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packets to be delivered, WRP tries to drop them which mean a lesser PDR. Furthermore, GR is a grid based approach and updates its CH information table periodically among other CHs which leads to an increase in the data collection. On the other hand, GR is a multiple sink concept and adapts faster than WRP to the change of the routing caused by mobile nodes in WSNs.

Our analysis showed that our protocol is very robust to data collection by independent mobile nodes as well as CHs, even when they have lowest energy, so the end to end delay has been reduced see (fig 1.0). To ensure the reliability and stability of the routing process here Efficient DMSS has been proposed. First it is provide a distributed, lightweight solution to the MS position verification problem that need not require infrastructure or a priori information and it is robust against several different issues. Next, it provides best selection of MS based on the energy, distance.

V. Conclusion and Future Work

In Wireless sensor networks data collection from energy constrained nodes is an important task. Mobile sink based data collection techniques has been introduced to perform optimal route planning, data collection scheduling, and fast emergency message gathering by discovering the multiple mobile sinks. This avoids data loss issues in energy restricted nodes by applying grid based data collection and dissemination by sharing the positions of MS with their neighbours and also addressed the selection of energy optimized node with stable path among the neighbours which not only describes the selection of correct position neighbours but also best link stability CHs. Thus overcome the data loss and also data dissemination failures. The availability of MS has been identified with the duration probability of mobile sinks that is subject to link failures caused by node mobility. The proposed work is implemented using NS-2. The performances are analysed and addresses that DDC scheme with DMSS has reduced the packet loss and delay and increases the packet delivery ratio and Energy of the network.

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