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# An Energy Efficient Data Reporting Technique in Wireless Sensor Networks

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***Abstract***

In large scale wireless sensor networks, data gathering using mobile sinks has drawn substantial interest in recent years .Currently it is based on planning the moving trajectory of mobile sink in advance to achieve optimized network performance. The pre-calculated trajectories may not be applicable if the mobile sink cannot move freely in a deployed area. In this paper an energy efficient data reporting technique has been proposed for mobile sink based data collection when a sink's future locations cannot be scheduled in advance. The main feature of this scheme is the sufficient flexibility in the movement of mobile sinks to dynamically adapt to various terrestrial changes without GPS devices. The proposed protocol establishes a logical co-ordinate system for routing and forwarding packets.

***Keywords**: Wireless Sensor Networks,logical coordinate,mobile sink,data gathering ,routing*



## I.INTRODUCTION

A WSN can be defined as a network of devices, denoted as nodes, which can sense the environment and communicate the information gathered from the monitored field (e.g., an area or volume) through wireless links. The data is forwarded, possibly via multiple hops, to a sink that can use it locally or is connected to other networks through a gateway. Recent research on data collection reveals that, rather than reporting data through long, multihop, and errorprone routes to a static sink using tree or cluster network structure, allowing and leveraging sink mobility is more promising for energy efficient data gathering[1].

Consider a WSN comprising homogeneous static sensor nodes. The sink can be static or mobile, and can be placed at different locations in the WSN. In the case of a static sink, nodes located in the vicinity of the sink deplete their energy (and die) much earlier compared to the nodes located farther away from the sink due to higher data relaying load. In order to address this issue, sink mobilization has been introduced, where the sink moves along a certain path through the network. It has also been shown that in most cases sink mobility helps in balancing the routing load and hence energy dissipation of the nodes .

However, data gathering using mobile sinks introduces new challenges to sensor network applications. To better benefit from the sink's mobility, many research efforts have been focused on studying or scheduling movement patterns. of a mobile sink to visit some special places in a deployed area, in order to minimize data gathering time. In such approaches a mobile sink moves to predetermined sojourn points and query each sensor node individually. A mobile sink can follow different types of mobility patterns in the sensor field, such as random mobility, predictable/fixed path mobility, or controlled mobility, which has consequences with respect to energy efficiency and data collection strategies.

In wireless sensor networks with mobile elements, the different types of Mobile Elements (MEs)[3] with increasing level of mobility, by focusing on architectural aspects. They are relocatable nodes, mobile data collectors and mobile peers. Mobile sink fall under the mobile data collectors. These are mobile elements which visit the network to collect data generated from source nodes. Depending on the way they manage the collected data, MDCs can be either mobile sinks or mobile relays.

These are mobile nodes which are the destination of messages originated by sensors, i.e., they represent the endpoints of data collection in WSN-MEs. They can either autonomously consume collected data for their own purposes or make them available to remote users by using a long range wireless Internet connection.

In these cases, ordinary sensor nodes are static and densely deployed in the sensing area. One or multiple MSs move throughout the WSN to gather data coming from all nodes. Note that the path between the source nodes and the MSs is multi-hop, although the actual path changes with time, since the position of the MS is not fixed.

In this paper, we propose an energy efficient data reporting technique SinkTrail, a proactive data reporting protocol that is self-adaptive to various application scenarios,with single and multiple mobile sink. In

SinkTrail, mobile sinks move continuously in the field in relatively low speed,and gather data on the fly. Control messages are broadcasted at certain points in much lower frequency than ordinarily required in existing data gathering protocols. Considering each footprint as a virtual landmark,[2]a sensor node can conveniently identify its hop count distances to these landmark.

## II. DESIGN OF SINKTRAIL PROTOCOL WITH ONE MOBILE SINK

Consider a large scale, uniformly distributed sensor network in which nodes communicate via radio links.We assume that the whole network is connected and nodes are awake when data gathering process starts.To gather data from the network , periodically send out a number of mobile sinks into the field.[4] These mobile agents, such as robots or vehicles with laptops installed, have radios and processors to communication with sensor nodes and processing sensed data. They are assumed to have unlimited power. A data gathering process terminates when either enough data are collected or there are no more data reports for a certain period.

Mobile sink stops at some places for a very short time, broadcasts a message to the whole network, and moves on to another place. These places are called “Trail Points,” and these messages are called“ Trail Messages.” The distance between two adjacent trail points should be separated by a distance longer than the average transmission range, otherwise, the hop count information will not be significantly different. In order to easily do the tracking ,we can assume that the distance between any two consecutive trial point are same.



The trial message from a mobile sink consist of two components a sequence number and hop count to the sink.To represent the logical coordinates in a network a vector called “Trial reference” is used. The trail reference maintained by each node is used as a location indicator for packet forwarding. All trail references are of the same size. During the data reporting two different stages are present. The two phases are logical coordinate space construction and greedy data forwarding.

During logical coordinate space construction, sensor nodes update their trail references corresponding to the mobile sink’s trail messages. Intially the trail references of all nodes are initialized to [-1,-1…] of size dv. A special variable is used to track the latest message sequence number is also set to -1. Mobile sink while entering the network first select a random palce as its first trial point and broadcast messages. The nodes nearest to S will be the first ones to hear this message. By comparing with the special variable if this is a new message, then the variable will be updated by the new sequence number and node updated its trail reference. After node updated its trail reference, this trail message is rebroadcasted with the same sequence number and an incremented hop count. The same procedure repeats at all the other nodes in the network.

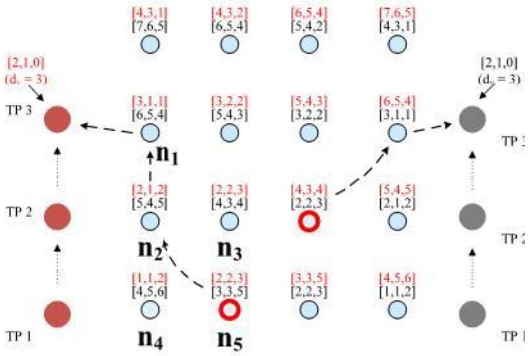
**Trial Reference Update algorithm of node ni:**

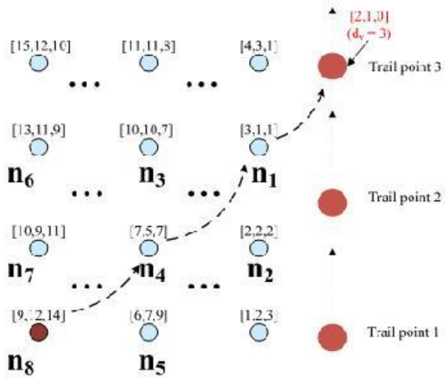
```
1. While data gathering is not over do
2. //When receive a trial message
3. if  seqno in the message >latest sequence no received L then
4.        latest seqno L=seqno
5.        shift vi to left by one position
6.        Update rightmost element in vi=hopc+1
7.        Update hop count distance hopc=hopc+1
8.        Rebroadcast message
9. else if seqno= latest sequence no received L
10.       Compare update rightmost element in vi
          with hopc+1
11.       if it is greater than hopc+1 then
12        Update rightmost element in the vector vi
          hopc+1
13.       hopc=hopc+1
14.       Rebroadcast message
15.       else discard message
16.       end if
17. else if seq no < latest sequence no received
18.       Discard the message
19. end if
20. end while

/* vi-trial reference vector of node ni
   ni-node i
  seqno-sequence number in the trial message
   hoc –hopcount value in the trial message
  L-latest sequence number variable*/
```

During the data gathering procedure, a node’s trail reference needs to be updated every time a new trail message is received. After each node in the network received dv distinct trail messages, the logical coordinate space is established. One main advantage of this scheme is that logical coordinate of the sink keep invariant at each trial point. The reason is that hop count distance of mobile sink to its previous footprints are always ( k[dv-1],k[dv-2],…1,0) to the current logical location of a mobile sink. This coordinate is called destination reference.

During the greedy data forwarding , once a node has updated the three elements in its trail reference, it starts a timer that is inverse proportional to the right-most element in its trail reference. The right-most element in a node’s trail reference is the latest hop count information from this node to a mobile sink. By using the timer mechanism the nodes farthest away from the sink will start data reporting since they have long hop count distance to the sink.

Also for data reporting, each node maintains a a routing table consisting of all neighbours' trail references. This is built up by exchanging trail references with neighbours and it is updated whenever the mobile sink arrives at a new trail point. When a node has received all its neighbours' trail references, it calculates their distances to the destination reference, according to 2-norm vector calculation, then greedily chooses the node with the smallest distance as next hop to relay data. If there is a tie the next hop node can be randomly selected.



## III. DESIGN OF SINKTRAIL PROTOCOL MULTIPLE MOBILE SINKS

The single mobile sink protocol can be readily extended to multiple mobile sink scenario.Each mobile sink broadcasts trail messages. To distinguish different mobile sinks a a sender ID field, msg.sID,is added to each trail message .Algorithms also get extended. Instead of using only one trail reference, a sensor node maintains multiple trail references that each corresponds to a different mobile sink at the same time.

One for each mobile sink, multiple logical coordinates are constructed concurrently. Each node checks the mobile sinks ID in the message and determine whether it has to create a new trial reference or not. If it finds a new sink ID it has to create a new trial reference for that sink.Trail references of each node represent node locations in different logical coordinate spaces, when it comes to data forwarding, because reporting to any mobile sink is valid, the node can choose the neighbor closest to a mobile sink in any coordinate space.

## IV SIMULATION AND RESULTS

The Simulation is carried out in NS2 under LINUX platform. The aim of these simulations is to analyze the Sinktrial protocol with multiple mobile sinks for its efficiency in terms of energy consumption, and throughput.

### *A. Simulation parameters*

*1.Energy consumption* The total number of energy consumed for packets transmitted and packets receiving during the simulation.

*2. Throughput* The throughput metric measures how well the network can constantly provide data to the sink. Throughput is the number of packet arriving at the sink per ms.

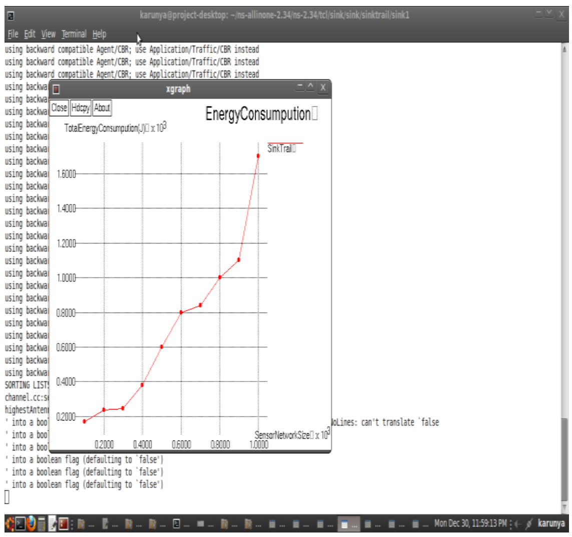



Fig 1 Energy consumption of the network

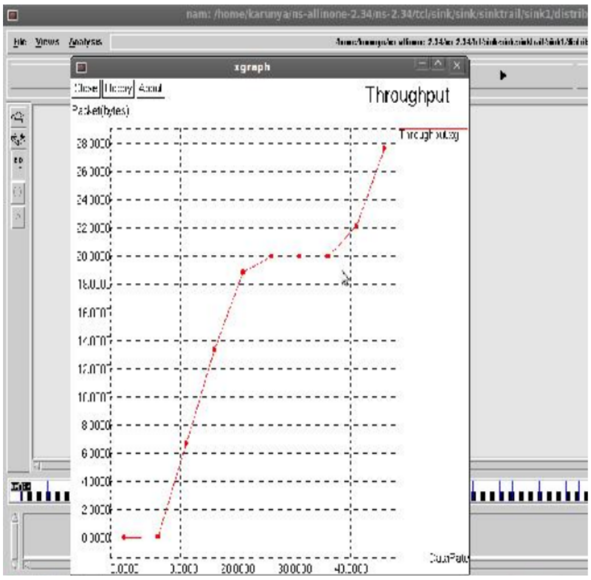



Fig 2 Throughput of the network

## V CONCLUSION AND FUTURE WORK

In this paper, we proposed an energy efficient data reporting technique in wireless sensor networks The proposed protocol is proposed for sensor nodes to efficiently report their data back to one of the mobile sinks. The proposed system uses logical coordinate routing to infer distances, and establishes data reporting routes and greedily select the shortest path to the destination reference. In addition protocol is capable of tracking multiple mobile sinks simultaneously through multiple logical coordinate spaces .It possesses desired features of geographical routing without using GPS devices or extra landmarks .As a future work we can extend the flat network into hierarchical network and compare the performance.



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