# Energy Efficient WSN using GPSR for Mobile Sink

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**Abstract:** ***In wireless sensor network (WSN) the use of mobile sink collector has been attracting more attention in recent times. The sensor nodes in WSN have small amount of power supply and storage hence: the mobile sink collectors are more effective way of balancing energy expenditure among sensors. In this paper, we consider applications, where sensing data are generally collected at a low rate and are not so delay sensitive that it can be collected into fixed-length data packets and uploaded once in a while. We propose a mobile data collector, which moves to the vicinity of the sensor nodes to collect data. A mobile collector will travel a sensing field periodically. When travelling through its transmission range, it polls each sensor. Thus it collects data from each sensor using one to one communication. As data packets are directly uploaded to the sink without relays, the energy consumed by the sensors will not be wasted in multi-hop relaying. In this paper, we discuss The Mobile sink which finds a route to the sensor node by using spanning tree covering algorithm. Sensor location information is collected using greedy perimeter stateless routing. We evaluated network performance by parameter energy consumption.***

**Keywords**: GPSR (Greedy perimeter stateless routing), Mobile collector, spanning tree covering algorithm, WSN.

## 1. Introduction

From past few years, WSNs have become a very popular type of networks which consist of distributed autonomous set of different types of sensor nodes which are spread over an area under interest. Sensor nodes are nothing but a device with a sensor which particularly deployed to sense some or other physical parameter of monitoring field. These WSNs are having a large variety of applications. It includes battlefield surveillance, medical treatment, habitat monitoring, border patrol, remote health monitoring, even to get early warnings of natural disasters such as forest fire, also used for wildlife tracking, smart transportation and many more [1-6] .

Sensor nodes are used to detect some physical phenomena like temperature, pressure etc. These sensor nodes are initially thrown into sensing field randomly. Normally they don't have any preconfigured infrastructure. So they have to discover nearby nodes and arrange themselves into a network before starting to monitor the sensing field. Though the applications of WSNs are much diverse they have a basic common feature that all sensor nodes have to sense field parameter i.e. to collect data packets and dump them to data sink. Energy of sensor nodes mostly consumed by two major tasks one is sensing the field and other is uploading the data to data sink. Energy required to sense the field is quite stable as it only depends on data sampling rate but energy needed to upload the data can vary from less to more depending on network topology, location of sensor node with respect to data sink. Many times sensor nodes faster run out of energy due to multi-hop uploading the data to data sink. So energy consumption becomes important factor to decide network lifetime. In a flat topology homogeneous network, sensor nodes which are close to the data sink consume more energy than sensor nodes which are located far from data sink at the margin of the network, because they need to relay many packets from other sensor nodes far away from the data sink. Because of this once these sensor nodes fail, other nodes cannot reach the data sink and ultimately the network becomes disconnected, even though most of the nodes still having enough battery power. Therefore, it is inefficient to use a single static data sink to collect data from all sensor nodes for a large-scale data-centric sensor network.

In some applications, some sensors cannot forward data to the data sink via wireless links, as the network may be partially connected. Because of these reasons, the idea of introducing mobility to data sink i.e. data collector comes into picture. Mobile data collector traverses through entire network and may links all separated sub networks together. Mobile data collector could be a mobile robot or a vehicle which must be equipped with a powerful transceiver, battery, and most importantly large memory. The mobile data collector starts travelling from the data sink, travels through the network and aggregate sensed data from nearby sensor nodes while moving, and then returns and uploads data to the base station. Due to mobility, it can move close to sensor nodes. This will save the energy of sensor nodes wasted in just relaying the data packets from other nodes. Here we consider network lifetime depending on analyzing energy consumption of network. Less the energy consumed, more will be the network lifetime and vice versa.

## 2. Related Work

R. C. Shah, et al. [7], present and analyze architecture to collect sensor data in sparse sensor networks. Their approach exploits the presence of mobile entities (called MULES) present in the environment. MULEs pick up data from the sensors when in close range, buffer it, and drop off the data to wired access points. This can lead to substantial power saving at the sensors BS they only have to transmit over a short range.

K. Singh and T. P. Sharma, [8] proposed a Reliable Energy-efficient Data Dissemination (REDD) scheme for WSNs. In this strategy, there are multiple sinks. By using geographical forwarding, first they determine the location of source and then directly do one to one communication with source node.

Each forwarding node generates a local zone. Each zone is having some sensor nodes. If forwarding node fails, then other nodes act as representative of it.

W. R. Heinzelman, A. Chandrakasan, and H. Balakrishnan [9] explain a homogeneous network having cluster heads. Initially all the nodes have identical energy. But cluster heads will consume more energy than other nodes. To avoid this problem all sensor nodes can get the chance to become cluster heads rotationally. But dynamic selection of cluster heads results in high overhead of the network.

Zhenghao Zhang, M. Ma, and Y. Yang [10] focused on the energy-efficient design within a cluster to prolong network lifetime. They used polling to collect data from sensors instead of letting sensors send data randomly so that less energy is consumed and showed that the problem of finding a contention-free polling schedule that uses the minimum time is NP-hard.

J. Luo and J.-P. Hubaux [11] explain a unified framework to analyze the *maximizing network lifetime* (MNL) problem in WSNs. It is based on a graph model, jointly considers sink mobility and routing for lifetime maximization. They have developed an efficient algorithm to solve the MNL problem involving only a single mobile sink; they have further generalized the algorithm to approximate the general MNL problem. In addition, using the duality theory, they have proved that, moving the sinks is always better than keeping them static.

M. Zhao and Y. Yang, and Z. Zhang [12],[13] explored a balanced technique comprising multi hop relay for local data aggregation and the moving tour length of the mobile collector by implementing polling. Also they focus on finding energy-efficient and collision-free polling schedules in a multi-hop cluster.

Wei Wang, Vikram Srinivasan [14], showed that even with one node as a mobile relay, a lifetime improves of up to four times over the static network in the ideal case.

## 3. Proposed Work

We propose WSN consisting of two protocols namely GPSR (Greedy perimeter stateless routing) [15] via which sensor node sends its location information to *Mobile collector*. Spanning tree covering algorithm [16] will be used by *Mobile collector* to plan the shortest tour towards sensor node. The figure1 indicates the scenario.

When Event occurs near node 27, it senses it and will start sending the data towards *M collector.*

1. Now node 16 is *M collector*. Node 27 broadcasts its location information in the network and informs about occurrence of event by considering node 16 as destination node.
2. All the nodes in network will try to forward this broadcast message towards *M collector;* node 16.
3. Node 16 will receive the request and process the packet to withdraw the location information of the source.
4. After getting location information of sensor node, node 16 will find shortest tour using spanning tree covering algorithm.

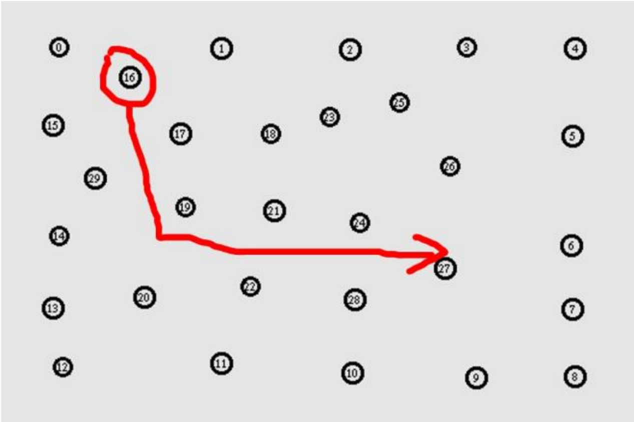

**Figure 1:** Node number 16 as Mobile Sink.

## 4. Implementation Steps in Network Simulator

1) Add GPSR.cc and related files in ns-2.34 installation directory
2) Compile with tcl object hook inside ns-2.34
3) Write TCL based front end script for simulation and experimentation
   3.1 Configure network for n number of nodes (where n=10, 20, 40 60, 80,100)
   3.2 Establish sink nodes and source nodes without and with mobility.
   3.3 Set gpsr protocol configuration for all wireless nodes along with 802.11 protocol
   3.4 Establish spanning tree covering algorithm link in ns-2.34 installation directory.
   3.5 create trace file and animator instances for further analysis
4) Write awk based analysis scripts, to analyze trace file generated in experimentation
5) Generate results from awk scripts for different nodes scenarios and collect in one file
6) Create graphical presentation from gathered data.

## 5. Result Analysis

For analyzing energy consumption of WSN for single static Vs single mobile collector scenario, we implement our algorithm on WSNs with 10, 20, 40, 60 80 and 100 number of nodes respectively. We run the simulation for 250 seconds in Network Simulator2 and then noted the observations.

Table 1 shows the total energy consumed by static and mobile sink networks consisting of different number of nodes scenario.

Based on our simulated experimentation we analyzed the effectiveness of using mobile sinks to collect data in wireless sensor networks. By comparing energy consumption of static sink and mobile sink networks we conclude that when sink collector moves to the vicinity of a sensor node to collect the data, significant energy savings can be obtained as single hop based route is selected.

**Table 1:** Energy Consumption Observations

| *Number of Nodes* | *Energy Consumed in Joules in Static Sink Scenario* | *Energy Consumed in Joules in Mobile sink Scenario* |
|---|---|---|
| 10 | 0.585256 | 0.603678 |
| 20 | 3.530063 | 2.135655 |
| 40 | 10.57225 | 6.377231 |
| 60 | 17.557959 | 10.615894 |
| 80 | 22.280018 | 14.83901 |
| 100 | 34.682024 | 25.201957 |

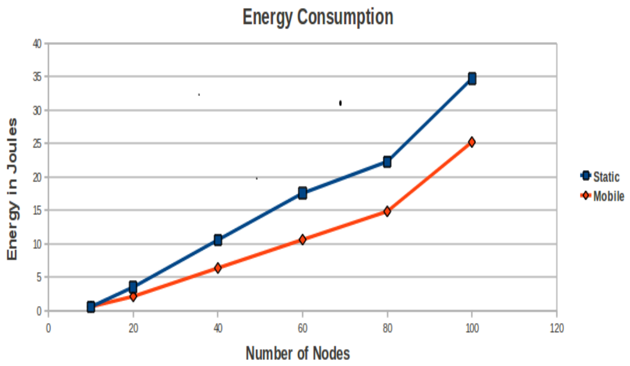


**Figure 2:** Energy Consumption Graph

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