# Single Sink Repositioning Technique in Wireless Sensor Networks For Network life Time Extension

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**Abstract -** *WSN is a large network consists of a group of spatially distributed autonomous sensors interconnected by means of wireless communication channels to monitor physical or environmental conditions. The consumption of energy in wireless sensor network is an important criterion. Wireless Sensor nodes carry limited generally irreplaceable power sources. One of the major problems while handling the wireless sensor network is the limited availability of the power for the sensor nodes. Due to this energy constrain the data needs to be managed wisely in order to extend the lifetime of the network. We have considered the problem of using static sink for data gathering purpose in an energy constrained multi hop wireless sensor networks. Sink relocation is an efficient network lifetime extension method, which avoids consuming too much battery energy for a specific group of sensor nodes as well as too small consuming battery energy for a specific group of sensor nodes as well. The sensor nodes far from the sink will generally consume more battery power than others; consequently, these nodes will quickly drain out their battery energy and shorten the network lifetime of the WSN. We address issues related to when should the sink node be reposition, where it would be moved to and how to handle its motion without any effect on data traffic. Our approach tracks the distance from the distant hops to the sink node and the distance of each node from sink node. This scheme basically finds the optimal location of the sink and the routing pattern to deliver the collected data to the sink. The sink node position is determined randomly within the network boundaries. Then the sink will move to optimum place inside transmission boundaries which is to decrease distance between sensor nodes and sink node. When distance between sink node and wireless node decreases energy consumption of individual node decreases which is used to increase life time of the whole network. For this we have used the repositioning algorithm which has been simulated in the NS-2.32 environment. Our simulation results show that repositioning the sink achieves significant energy savings as compared to the static sink approach which helps in improving the life of the entire network.*

***Key Words***: Energy efficient, Sink Reposition, wireless sensor network, life time, energy consumption, Sink node

## 1. INTRODUCTION

Wireless Sensor Networks (WSN) is a large network consists of a group of spatially distributed autonomous sensors interconnected by means of wireless communication channels to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. Sensor node is a small device, which is used to gather data from its neighboring area, perform simple computations, and communicate with other sensors or with Base Station (BS) [1]. Because of this property, WSN becomes a vital topic with the rapid development that is susceptible to a wide range of attacks due to deployment in the hostile environment. Such networks have been realized due to recent advances in micro electromechanical systems and are expected to be widely used for applications such as environment monitoring, home security, and earthquake warning. Attribute of sensor networks, is the cluster of sensor nodes, to generate high class information about the sensing surroundings. These nodes are self-organized. They are competent of wireless communication. It is forced in circumstances of memory; dimension, energy, processing power and sense environmental data. Sensor nodes perform an inadequate/limited processing & communicate over short distances [2]. Thus; a wireless sensor network has sensing component as well as the capabilities of, on-board processing, storage and communication. By these improvements, a sensor is prone for data collection correlation, in network examination and combination of other sensor nodes data and its own sensor data also. While several sensors nodes supervise the large physical environment, they structure a wireless sensor network.

There are basically two components in the infrastructure of a wireless sensor network: **sink nodes** and **sensor nodes**. Sink nodes are considered as base stations in the network that wirelessly receive and collect data packages generated from all the sensor nodes in the network and provide them to users. A sink or base station acts like an interface between users and the network. From the base station users can access the data, possibly through internet, for further processing of the data and to extract useful information. Depending on the network size and network topology, there could be one or multiple sink nodes and the sink nodes can either be stationary at one position or patrolling in the network area. The sink node with base station functionality is usually supplied with large energy reserve and large computational power as it works as a pivot in the sensor network system [3].

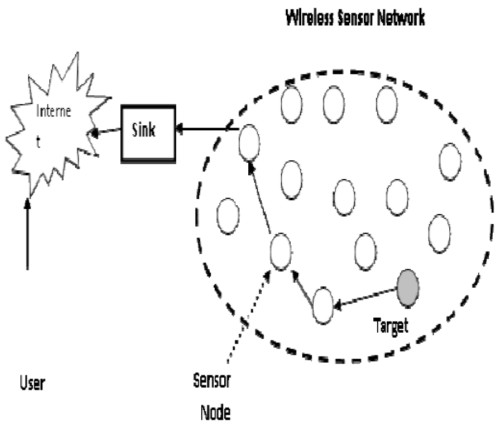


Figure 1 Wireless Sensor Network

## 2. PROBLEM IDENTIFICATION

Sensors are usually battery operated and have a limited transmission range and on board processing capacity like memory, processing, energy and power. Such constraints have motivated lots of research on effective management strategies of WSN's that trade off resources ,data fidelity, latency and coverage so that the network can stay functional for the longest duration. The interest in optimizing the transmission energy tends to increase the levels of packet relaying and thus makes queuing delay an issue especially for real time traffic. The wireless sensor node can only be equipped with a limited power source. Sensor lifetime shows a strong dependency on battery lifetime. In multi hop sensor network, each node plays the dual role of data originators and data router. The dis functioning of a few nodes can cause significant topological changes and might require rerouting of packets and reorganization of the network. Hence power consumption and power management take on additional importance.

Energy efficient data routing in wireless networks generally pursue multi hop paths for minimizing the total transmission power which is generally proportional to the distance squared or even higher in order for environment reach with obstacles and interference sources. The basic idea of multi hop network paths is to shorten the distance so that significant power savings can be achieved. But in case of wireless sensor network all the sensors will forward their data to the sink. So the sensors which are nearer to the sink have to take the heavy traffic load because of which they will start depleting their energy faster and soon they will completely deplete their energy. Now the sink will have to rely on the other sensors which are quite far off. This will result in increase in the transmission power. Thus in case of Multi-hop relaying some sensors have to relay a lot of traffic for the other sensors and this gives rise to unbalanced energy expenditure over different parts of the fields. However to provide solution over this problem some methods were proposed wherein they tried to solve this problem by placing more sensor nodes around the sink. However this resulted in an unbalanced sensing coverage over different parts of the fields. The main aim of the energy optimization in sensor networks is to prolong the life of a single node as well as of the entire network [5][6] [4].

## 3. METHODOLOGY OF SINK REPOSITION

Both the problem of Multi-hop relaying and multiple sinks can be avoided by sink repositioning technique which involves making use of the mobile sink which has the capability to move inside the monitored region and collect the data from the sensors it passes by. During sink repositioning the distance of each node from sink node is calculated, and then the optimal location for the sink is calculated. The longest distance node from sink consume more energy to transmit packet than other nearest node and these node deplete its energy before all other node which lead to energy hole problem. In order to test for the impact of repositioning the total power transmission of the sensors for the previous and next sink positions is evaluated and compared. Then the gain in terms of power transmission is checked and if it is more than a particular threshold value then only the sink will be moved to a next position or its optimum position otherwise it remains at the previous location and if further the overhead is justified then only the sink will finally move to the next position. When the sink starts to move towards its next location at each step the algorithm will check the list of sensor nodes that are last hop away from the sink in order to check for their connectivity with the sink. If the sink is reachable then the last hop sensor nodes will adjusts its transmission power so that the sink can receive the messages properly. That means as sink node move to central position, the distance of last hop node from sink node is decreases and energy consumption also decreases.

**Flow chart of Sink reposition**

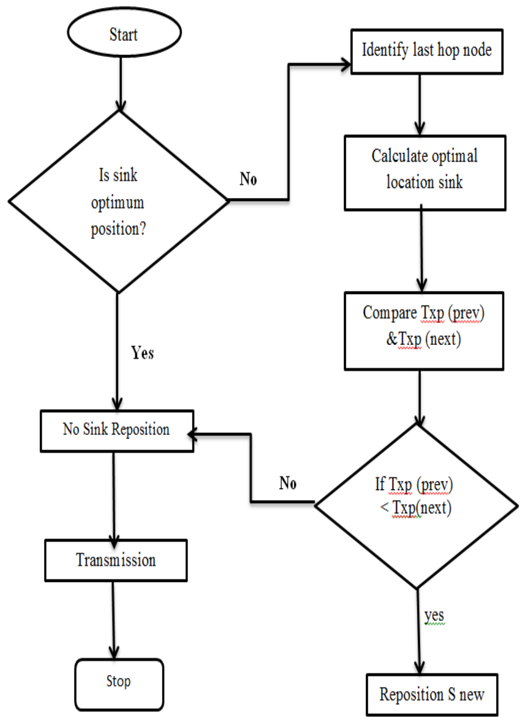


Figure 2 Flow chart of sink Reposition

## 4. ALGORITHM FOR SINK REPOSITIONING

1. Select sink node S from wireless nodes in the transmission boundaries of X, Y Position.
2. Put Sink node S randomly in the (X, Y) position.
3. Calculate the distance D between each node and sink node using Euclidean distance formula [7].

$$Dist(X,Y) = \sqrt{(x1 - y1)^2 + (y1 - y2)^2}$$

4. Calculate Energy consumption Etx of each node to transmit and receive packet based on distance from sink node by using energy consumption formula [8].

$E_{Tx}(k, d) = E_{elec} \times k + \varepsilon_{amp} \times k \times d^n$

5. Calculate average position for Sink node in the transmission boundaries (X,Y).

avgX =(sumx(Dist)/number of node
avgY =(sumy(Dist)/number of node
New position for Sink node is (avgX,avgY)

6. Repositioning the sink node to new calculated position for sink node (avgX,avgY) in the transmission boundaries.
7. Then repeat step 3 and step 4 respectively.
8. Compare the distance and energy consumption of each node before and after sink repositioning.

## 5. SYSTEM MODEL AND PARAMETERS

The Network Simulator (NS-2) is used to simulate the proposed architecture. In the simulation, the wireless node and sink nodes in a 1400 meter x 1200 meter region for 120 seconds of simulation time. All nodes have the same transmission range of 250 meters. The proposed Single Sink Relocation is mobile in side transmission region until it gets optimum location. After sink reaches its optimum location sink node stay new position permanently and receive data from other nodes. In these experiments, we measure how the network lifetime is extended before and after sink move. The performance is evaluated mainly, distance between each node and sink node, Energy consumed before sink move for each node and after sink move, residual energy of each node.

**Parameter used**

| Parameters | value |
|---|---|
| Number of Nodes | 36 |
| Mac | IEEE 802.11 |
| Maximum transmission range | 250 meter |
| Initial energy | 0.01J |
| Size of the data packet | 8 bits |
| Energy dissipation for electronic processing ($E_{elec}$) | 50nJ/bit |
| Amplifier energy dissipation ($E_{amp}$) | 100pJ/bit |

Table 1 Parameter Used

## 6. SIMULATION RESULTS

After compiling our code in ns-2.34 we get a nam file which should be opened in nam console to see the visualization of our wireless sensor network (wsn) and the graph is plotted by using MATLAB

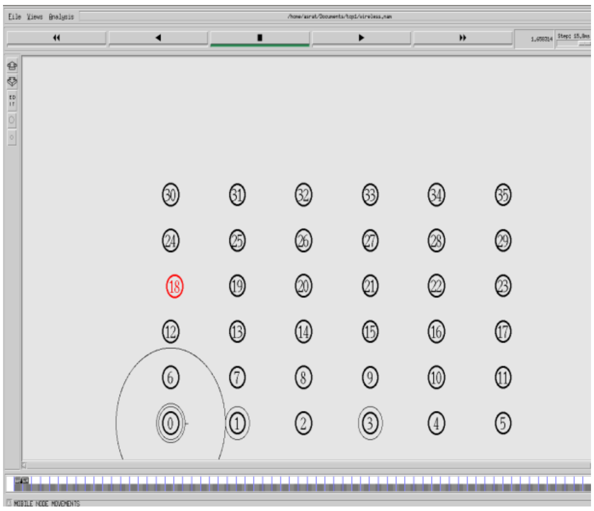

Fig.3: Output before sink repositioning

Figure 3 shows that node number 18 coloured by red colour is selected as sink node before reposition. As we see from figure some nodes are very far from sink node while some nodes are near to the sink

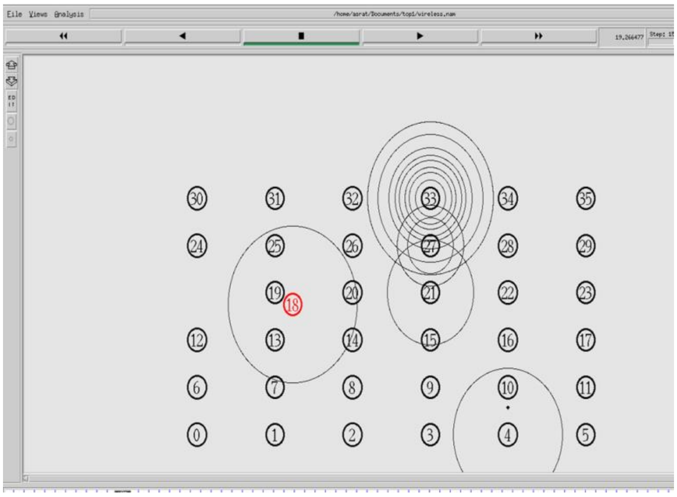

Fig.4: Output during sink repositioning

Figure 4 shows that during sink node movement to optimum position. During sink movement to optimum position the distant node adjust its transmission power as distance decreases and energy consumption also decreased.

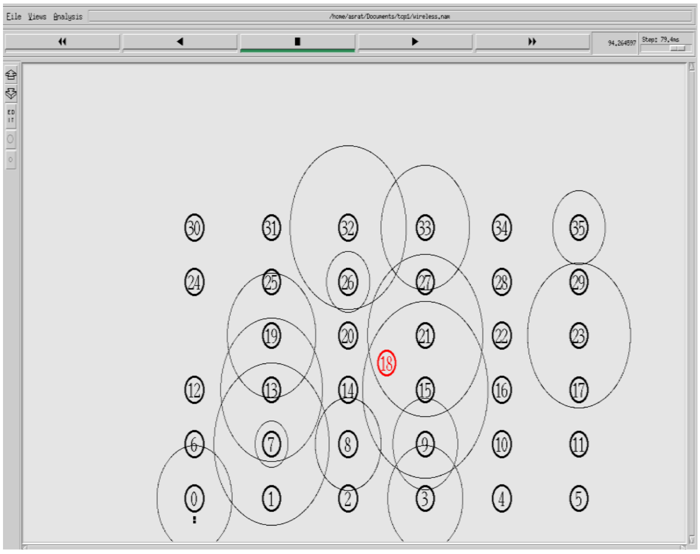

Fig.5: Output after sink repositioning

Figure 5 shows that after sink node reach optimum position and receive packet from nodes. Sink node stay permanently after it reaches its optimum position and continue its communication with nodes. Sink repositioning helps to avoids consuming too much battery energy for a specific group of sensor nodes as well as too small consuming battery energy for a specific group of sensor nodes as well.

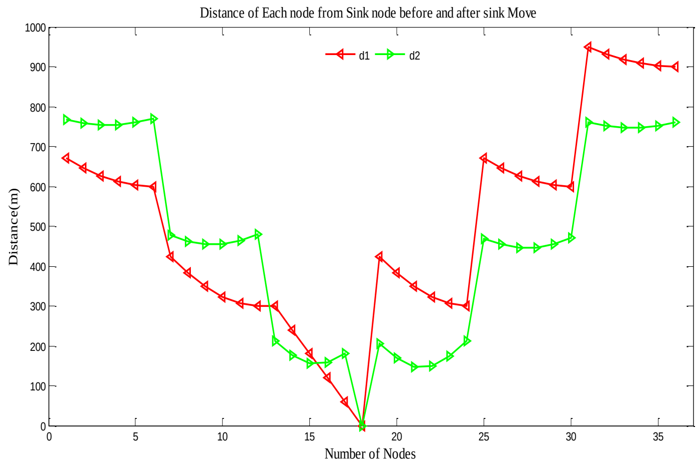


Fig 6 Distance vs nodes

(d1=distance before sink Reposition d2= distance after sink Reposition)

Figure 6 shows that the distance of each node from sink node before (d1) and after (d2) sink repositioning. The distance of nodes from sink node is balanced after sink repositioning.

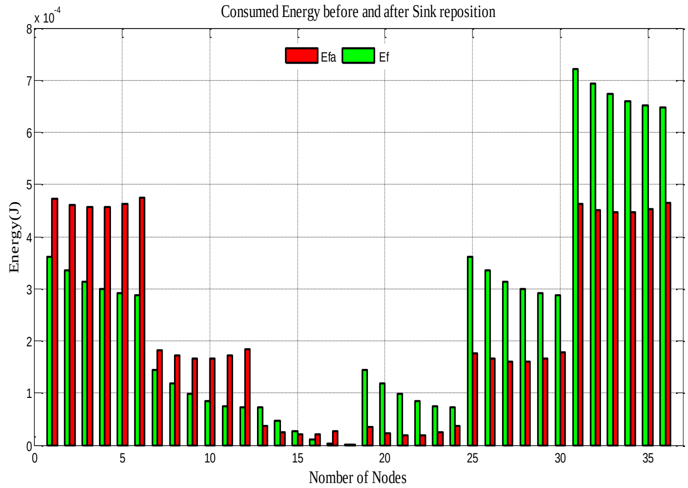


Fig 7consumed Energy vs Nodes

( Ef= energy consumption before sink reposition
Efa =consumed energy after sink reposition)

Figure 7 shows the energy consumption before sink reposition (Ef) and after Sink reposition (Efa) for the data transmission of single node. It shows that energy consumption of some node is greater than other node energy consumption where as some node energy consumption is less than other node. This difference is occurred due to the distance between each node and sink node is varied. Nodes which consume more energy are nodes which have more distance from sink node. But energy consumption of some nodes decreases whereas energy consumption of some node increases. These is the effect of sink repositioning because sink moved to node is decreases its distance and decreases energy consumption whereas node sink node moved from is increases its distance and energy consumption.

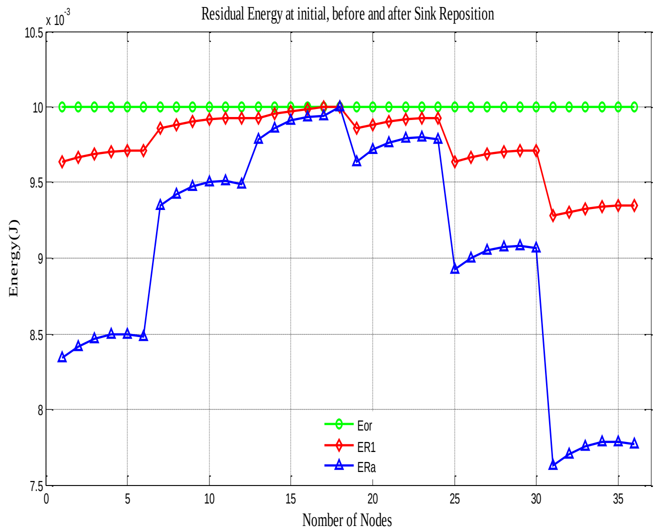


Fig 8 Residual energy before and after sink repositioning

(Ei= initial energy, ER1= Residual Energy before sink repositioning, Era= Residual energy after sink repositioning)

Figure 8 shows that the residual energy at initial (Eor) which is equal for all wireless nodes. After first run of single simulation before sink Reposition (ER1) different residual energy because of each node founds at different distance from sink node. A node which found nearest to sink node have high amount of residual energy whereas node found at long distance residual energy is very low because energy consumption of each node depends on distance of nodes from sink node. Residual energy after sink repositioning (Era) is low because previous residual energy becomes initial energy after sink repositioning. Sink will communicate with other node during movements, so residual energy is getting low, but energy consumption of single node after sink reposition is decreased as we discussed above on figure 7.

## CONCLUSION

It was observed that both the drawbacks of multi hop transmission and deployment of multiple sink in wireless sensor networks can be overcome by making use of sink repositioning. A repositioning sink is another approach for prolonging network life by avoiding staying at a particular location for too long which can damage the life time of distance nodes. The presented approach considers relocation of the sink node by checking the location of the nodes that are distant-hop away from the sink and their distance from the sink node. Long distance nodes consume more energy than other node. Energy consumption of node is directly proportional with the distance. In this paper we have investigated the performance advantage of repositioning the sink node of wireless Sensor networks. Simulation results have shown that such repositioning of the sink increases the average lifetime of the nodes by decreasing the average energy consumed per packet. It achieves significant amount of energy savings as compared to the base line approach. As a future work, we plan to extend the approach so that it will allow transmission of packets during movement of the sink even if the node goes out of the transmission range of the sink. Furthermore we plan to show energy consumption of node during sink movement to optimum location and show the distance and energy consumption at each level. The work can further be extended for increasing the throughput and reducing the delay for any particular scenario of the wireless sensor network.

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