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Energy Efficient Sink Relocation Scheme (Ee-Srs) For Enhanced Network Lifetime in Wireless Sensor Networks

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Abstract: Wireless sensor networks are embedded with distributed set of sensor nodes that are cooperatively monitor physical or environmental conditions, and send their information to a "sink" node over multi hop wireless communication links. The sensor nodes battery energy depletion will significantly affect the network lifetime of a WSN. Most researchers have aimed to design energy-aware routing protocol to minimize the usage of the battery energy to prolong network lifetimes. This paper proposes a sink relocation approach for efficient utilization of sensor's battery energy called Energy Efficient Sink Relocation Scheme (E-SRS) which considers regulation of transmission coverage range depend on the residual energy of a sensor node. The EE-SRS proposed in this paper discusses the algorithm to find the optimal place for relocating the sink, and "when and where to relocate the sink". The EE-SRS algorithm is developed and simulated using network simulator. The performance analysis has also been done in terms of the network lifetime, throughput and packet delay.

Keywords: sink relocation, battery energy, throughput, energy efficiency.

1. Introduction

A wireless sensor network (WSN) consists of a large number of small sensor with limited energy source. Prolonged network lifetime, scalability, node mobility and load balancing are important requirements for many WSN applications [11]. The various applications that wireless sensor networks play a vital role is environmental monitoring, intrusion detection, battle field, military applications and so on. WSN comprises of little measured sensor gadgets, which are outfitted with restricted battery control and are skilled of remote interchanges.

At the point when WSN is deployed in a detecting field, these sensor hubs will be in charge of detecting remarkable event (e.g., a flame in a woods) or for gathering the detected information (temperature or stickiness) of the environment. The wireless sensor node which detects an abnormal event will send the information to the exceptional hub, called a sink hub, through the multi hop transmission. All in all, because of the tangible situations being brutal by and large the sensors in a WSN are not ready to be energized or supplant when their batteries channel out of force. The battery depleted out hubs might bring about a few issues. In this manner, a few WSN contemplates have occupied with outlining effective strategies to moderate the battery force of sensor hubs, for instance, planning obligation cycle planning for sensor hubs to let some of them occasionally enter the rest state to save vitality power, yet, not hurting the working of the detecting employment of the WSN [1]; outlining vitality effective directing calculations to equalization the utilization of the battery vitality of every sensor hub [4]; or utilizing some information collection strategies to total comparable tangible information into a solitary datum to lessen the quantity of transmitted messages to expand the system lifetime of the WSN [5].

Figure 1 shows the sensing and forwarding of the information detected by the sensor node which is then routed to the sink node A through the route e − d − c − b – a. The sink will then forward the message through to the supervisor through the Internet. The WSNs are most widely used in climate change monitoring such as temperature, pressure, humidity etc., and also combat zone observation, stock and assembling forms and so on [1].

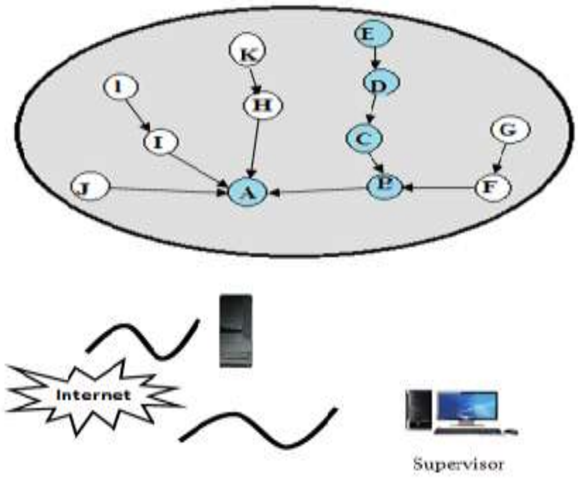


Figure 1: working scheme of WSN

The large portion of these methodologies can exist together in the working of the WSN. The other vitality rationing methodology is to utilize portable sensors to alter their areas from a district with a high level of aggregate battery vitality of hubs to a low vitality locale [5], [6]. Despite the fact that this methodology can expand the system lifetime of a WSN, the migration of sensor hubs will likewise grow their battery vitality. A bargain methodology is to utilize a versatile sink to migrate its position as opposed to moving the sensor hubs [7], [10].

As appeared in the first part of Figure 2, the sensor hub a close to the sink will rapidly deplete out its battery power in the wake of handing-off a few rounds of detected information with reported assignments being performed by other sensor hubs, also, hence the WSN will kick the bucket. Hub is called a hotspot. On account of the sink being fit for moving, sometimes recently the problem area hub a channels out the greater part of its battery vitality, the sink can move to another position to improve the circumstance of overwhelming vitality utilization of hub A.

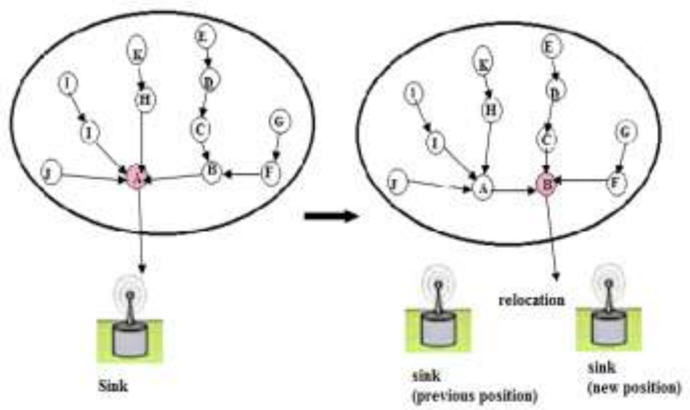


Figure 2: Relocating position of sink in WSN

The Figure 2 shows the migration of the sink from its position of hub A to the adjacent hub A. In such a way, the part of the hot spot will be operated starting with one hub then onto the next hub and hence the system lifetime will be developed. A few examination works have proposed systems for the sink migration approach [7], [10]. These studies can be generally characterized into two classifications, the foreordained sink versatility way [7] and independent sink development [8], [10].

In this paper, a sink relocation mechanism in extension over the network Lifetime which avoids too much of consuming battery power is analyzed. The nodes which are nearer to the sink will generally requires more battery power, hence, these nodes will quickly drain out their battery power. The sink relocation scheme explained in this paper uses the Energy Efficient Sink Relocation Scheme (EE-SRS) for mobile sink in Wireless Sensor Network. This sink relocation scheme decides "when and where to move the sink" that is based on the threshold values of the parameters.

The rest part of the paper is organized as follows. The literature survey in the area of sink relocation is discussed in Section 2. The AODV protocol is discussed in Section 3. Energy Efficient Sink Relocation Scheme (EE-SRS)is presented in Section 4. Section 5 discusses EE-SRS algorithm. The performance analysis of the proposed technique is discussed in Section 6. Finally Section 7 concludes the Pattern Viable restoration Key based encryption technique.

2. LITERATURE SURVEY

G.S.Sara [1] discussed the method of sink mobility scheme, usually routing process in a mobile network is very complex and it becomes even more complicated in MWSN as the sensor nodes are low power, cost effective mobile devices with minimum resources. Recent research works have led to the design of many efficient routing protocols for MWSN but still there are many unresolved problems like retaining the network connectivity, reducing the energy cost, maintaining adequate sensing coverage etc. This paper addressed the various issues in routing and presented the state of the art routing protocols in MWSN. The routing protocols were categorized based on their network structure, state of information, energy efficiency and mobility.

H.R.Karkvandi [2] proposed one category of sink relocation which discusses about the two main challenges ahead of an ad-hoc, sensor-based, battery operated monitoring system known as wireless sensor network (WSN) such as lifetime-aware routing and desired sensing spatial coverage (SSC). Depending on the application, a necessary SSC level is essential to comply with the needed surveillance quality. On the other hand, network lifetime is of a major concern due to limited energy available to each sensor node. Formerly proposed lifetime-aware routing algorithms have usually defined lifetime as the duration before the first node runs out of energy. This criterion is not consistent with real-world WSN, where a number of sensors are likely to "die" due to hardware failures, natural impacts. The proposed EE-SRS rectifies these limitations.

The relocation of the sink is based on Unbalanced energy consumption is an inherent problem in WSNs, characterized by multi hop routing and a many-to-one traffic pattern. This uneven energy dissipation can significantly reduce network lifetime. A new routing method for WSNs extend network lifetime using a combination of a fuzzy approach and an A-star algorithm which is given by I.S.Alshawi [3]. To demonstrate the effectiveness of the proposed method in terms of balancing energy consumption and maximization of network lifetime,

Y.Yang proposed [9] the mechanism based on optimization algorithm. Sensors have limited energy source and the sensor network is expected to be functional for a long time, so optimizing the energy consumption to prolong the network lifetime becomes an important issue. In static sensor networks, if sensors are uniformly deployed, sensors near the sinks die first. This is because besides sending their own sensed data, they also participate in forwarding data on behalf of other sensors located farther away from the sink. This uneven energy consumption results in network partitioning and limitation of the network lifetime.

3. Routing protocol

3.1Ad Hoc on-Demand Distance Vector Routing (AODV)

The Ad Hoc On-demand Distance Vector (AODV) routing protocol builds from the DSDV algorithm. AODV is an improvement on DSDV because it typically minimizes the number of required broadcasts by creating routes on a demand basis, as opposed to maintaining a complete list of routes as in the DSDV algorithm. AODV classify as a pure on-demand route acquisition system, since nodes that are not on a selected path do not maintain routing information or participate in routing table exchanges.

3.2 The Dynamic Source Routing (DSR)

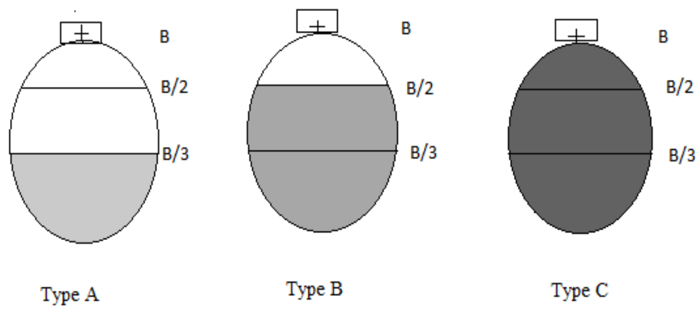
Distance-vector protocols are based on calculating the direction and distance to any link in a network. "Direction" usually means the next hop address and the exit interface. The Dynamic Source Routing (DSR) protocol presented in is an on-demand routing protocol that is based on the concept of source routing. Mobile nodes are required to maintain route caches that contain the source routes of which the mobile is aware. Entries in the route cache are continually updated as new routes are learned. The protocol consists of two major phases: route discovery and route maintenance. When a mobile node has a packet to send to some destination, it first consults its route cache to determine whether it already has a route to the destination. The route is not already there in route cache, it will execute the route discovery phase to find the appropriate route.

4. ENERGY EFFICIENT SINK RELOCATION SCHEME (EE-SRS)

WSNs can be ordered into two classifications, stationary and mobile or re-locatable WSNs, contingent upon whether the sinks are fit for moving or not. At the point when a stationary wireless sensor node sent the information collected in a detecting field, every sensor sink situated in a position performs event detection and message reporting/handing-off assignments until the sink out their battery vitality; at that point the node passes on. This leads to connectivity failure or link failure. In the case of mobile/re-locatable WSN, sensor hubs or the sink are fit for moving, means that the sink is having mobility property.

As the aggregate energy level of a region drops down to a low level state or there are some detecting gaps or corresponding openings in the region because of some sinks depleting out their battery energy, then some portable sensor nodes can migrate their areas also, move into this locale to alleviate the above issue. In spite of the fact that this methodology can draw out the system lifetime of the WSN, the moving sensors will likewise expend their battery energy to perform the mobility action. Sink migration is a bargain approach for dragging out system lifetime and the sensor hubs stay stationary to monitor battery vitality.

4.1 Transmission range regulation for efficient energy utilization



Transmission range = δ/4 Transmission range = δ/2 Transmission range = δ

Figure3: Transmission range regulation based battery energy

In general, a sensor node with larger transmission range will increase the number of neighbors and consequently improve the quality of the energy-aware routing; however, it also has a shortcoming of longer distance message forwarding, which will consume more battery energy of a sensor node. The parameter B used in this algorithm indicates the level of battery energy value. The value of the parameter B is initially full. Re (s) signifies the present leftover battery energy of a sink s ЄV where V is the graph. On account of the battery energy value of 0 ≤ Re (s) < B/3 or /3 ≤ Re (s) < B/2), then sink has used the transmission range regulation of Type A with transmission range δ/4 or of of Type B with transmission range δ/ 2 where δ indicates the initial transmission coverage range of a sink. For the instance of B/2 ≤ Re (s) ≤ B, the sink is exceptionally solid for its battery energy of type C transmission with transmission range δ and EE-SRS algorithm sets its transmission range to δ. Figure 3 shows the regulation of transmission range based on the residual energy of the sensor node. In the proposed method, transmission range regulation depends on the residual battery energy of a sensor node. Thus the adjustable transmission range and threshold value can prolong the lifetime of the wireless sensor network sensor nodes.

4.2 EE-SRS Algorithm

For each relocating steps, the determination criteria for selecting relocating position is an important step before moving to destination place. The sink gathers the remaining battery energy from every sensor hub inside of the correspondence scope of the sink. Initially the battery energy is high which is equal to B. The battery energy is checked after every transmission of the data. The battery energy of the sink is compared based on the condition sown in the Figure 3, if the initial battery energy in the first step is satisfied, The regulation of the transmission range has been obtained. This transmission range may be either Type A or Type B. Otherwise; the Type C transmission will be occurred. The relocation of sink takes place based on the criteria, finally, it enters into the correspondence scope of the moving destination. The developed EE-SRS algorithm for sink repositioning adopts the energy efficient routing as the underlying routing method for message forwarding.

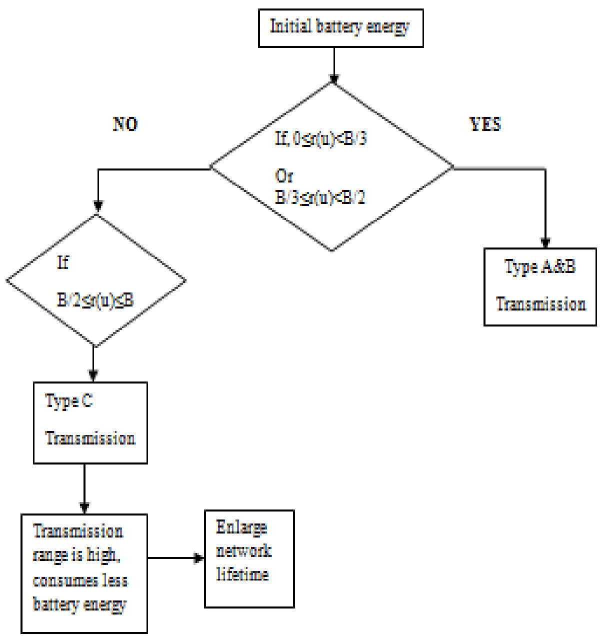


Figure4: EE-SRS Algorithm

5. Performance Analysis

The proposed EE-SRS scheme has been developed for efficient utilization of nodes' battery energy and the proposed algorithm has been simulated using Network Simulator (NS2). It uses the simulation area of 1000x1000. The performance of the network has been analyzed with 50 nodes and each node is having an initial energy of 100J.

Table1: Simulation parameters

PARAMETERS	VALUES
MAC type	802.11
Initial battery energy(J)	100
Antenna	Omni directional antenna
Receiving antenna gain	1
Transmitting antenna gain	1
Simulation area (m^2)	1000*1000
No of nodes	50

Figure 5 through Figure 8 show the different scenario of the EE-SRS algorithm. The node joining and the control message transmission are shown in Figure 5. Initially all the nodes are having same battery energy. During this time the "Node 32" performs as Sink node. Hence it receives the information from the node within its coverage range. Each transmission or reception, the sink node depletes its energy. Once the battery energy of the sink node reaches its lower level, it retries from its sink position which is shown in the Figure 6 and Figure 7. Once the node 32 retires, node 17 takes responsibilities of the sink. Figure 8 shows the Sink relocation takes place from node 17 to node 37.

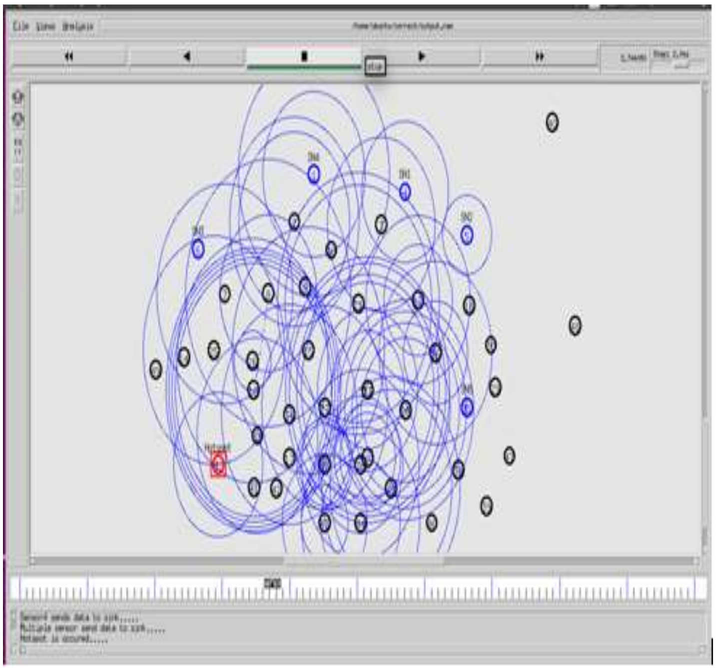


Figure5: Broadcasting of control messages for joining the network

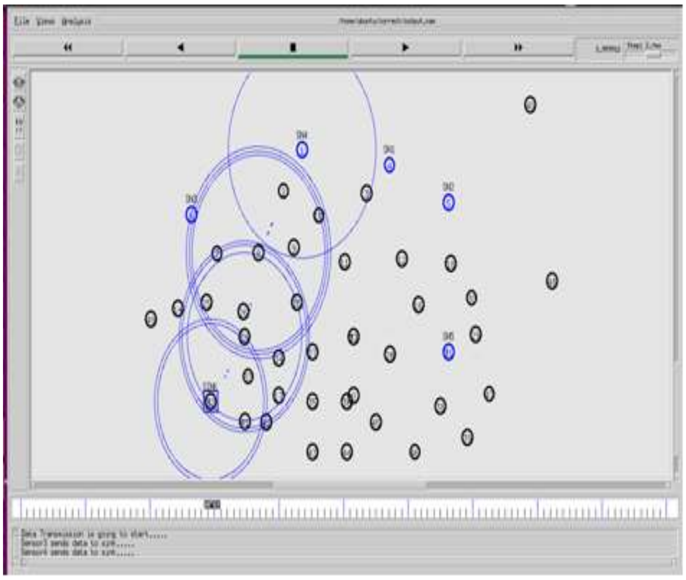


Figure 6 : Node 32 as a Sink

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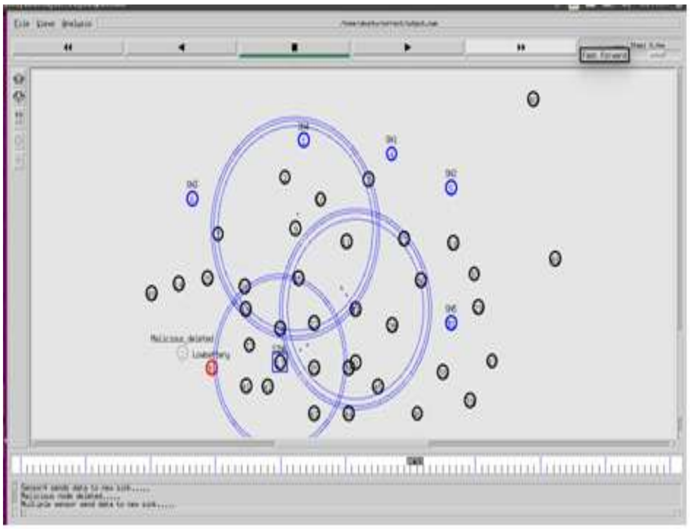

Figure7: Low battery energy of 32 and sink location moved to node 17

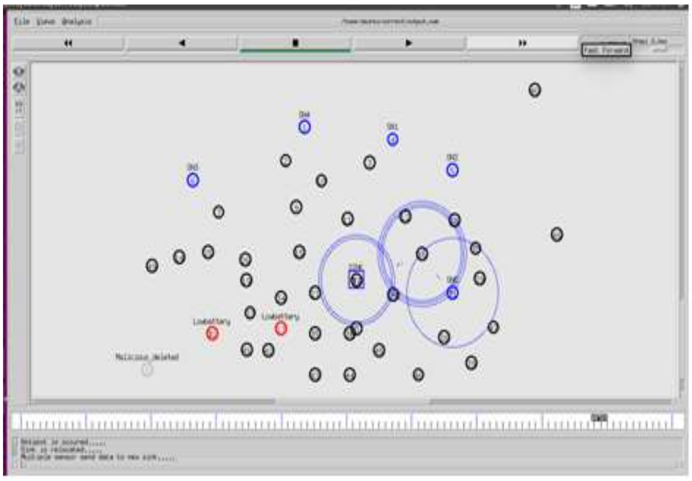

Figure 8: Sink location moved to Node 37from Node 17

The efficient energy utilization of the sensor network is shown in Figure 9. The EE-SRS algorithm is simulated with two different scenarios and its energy optimization performance is analyzed with its speed. The outcome shows that the proposed algorithm maintains its full battery energy for long time. Hence the increased network life time has been achieved.

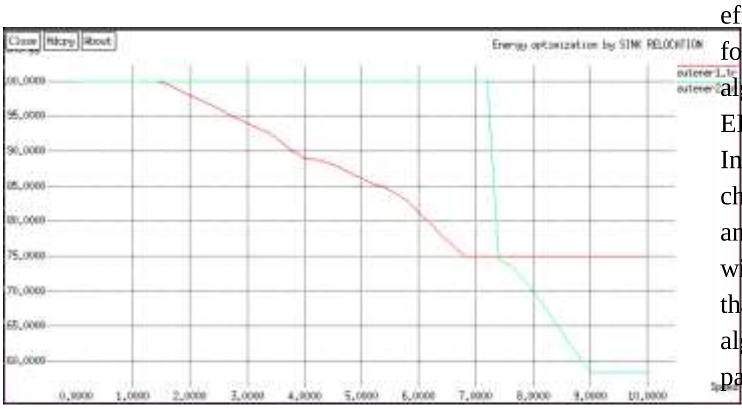

Figure 9: Energy Optimization

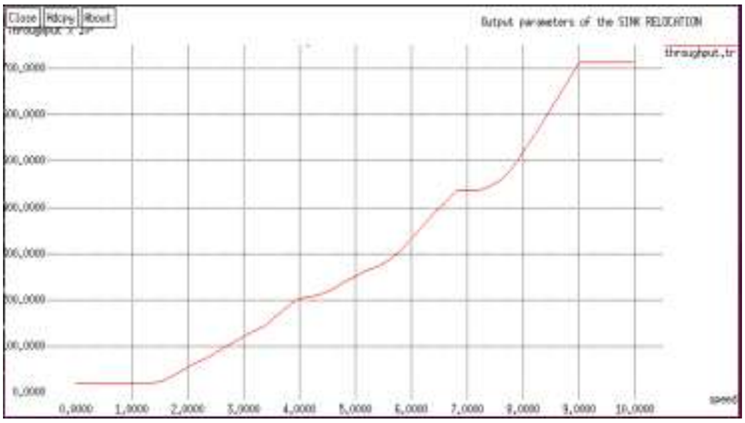

Figure10: Throughput

Figure 10 and Figure 11 shows the throughput and packet delay performance of the EE-SRS algorithm. The EE-SRS algorithm achieves increased throughput because of criteria used for sink relocation. The criteria consider the transmission range is the one of the criteria parameter; hence it achieves less packet delay.

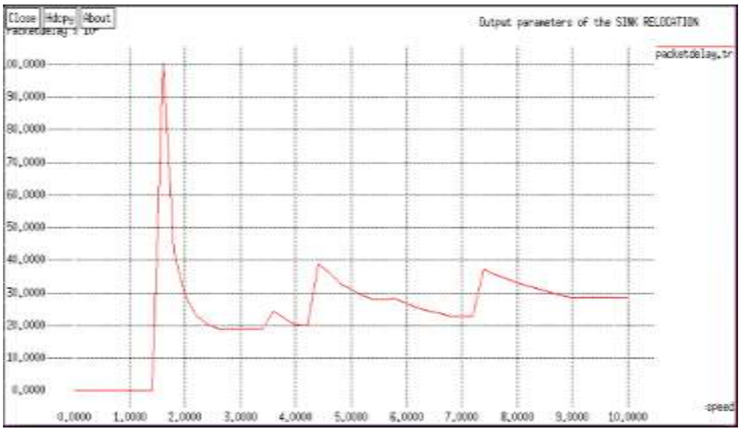

Figure 11: Packet delay

6. Conclusion

The shortcomings of multi hop transmission and deployment of multiple sink in wireless sensor networks can be overcome by making use of sink repositioning. This paper developed EE-SRS algorithm for sink repositioning which adopts the energy efficient routing as the underlying routing method for message forwarding. The simulated outputs prove that the EE-SRS algorithm has achieved network lifetime enhancement since EE-SRS avoids sink position at a certain location for too long. In addition to the network lifetime, other performance characteristics like packet delay, throughput also been analyzed. The simulation of EE-SRS algorithm has been done with different network scenario and the simulated results show that the EE-SRS algorithm performs well. The EE-SRS algorithm developed in this paper considers criteria with two parameters and in future time management based EE-SRS algorithm has to be developed and its performance also to be analyzed.

7. Reference

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Author Profile

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