"LOW COST DISPOSABLE MOBILE RELAYS TO REDUCE THE TOTAL ENERGY CONSUMPTION OF DATA-INTENSIVE WSN"

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ABSTRACT: *Wireless Sensor Networks (WSNs) are increasingly used in data-intensive applications such as microclimate monitoring, precision agriculture, and audio/video surveillance. A key challenge faced by data-intensive WSNs is to transmit all the data generated within an application's lifetime to the base station despite the fact that sensor nodes have limited power supplies. We propose using low cost disposable mobile relays to reduce the energy consumption of data-intensive WSNs. Our approach differs from previous work in two main aspects. First, it does not require complex motion planning of mobile nodes, so it can be implemented on a number of low-cost mobile sensor platforms. Second, we integrate the energy consumption due to both mobility and wireless transmissions into a holistic optimization framework. So we proposed an energy efficient data gathering process through clustering method.*

Keywords: Wireless sensor networks, energy optimization, mobile nodes, wireless routing, data aggregation.

1. INTRODUCTION

Wireless Sensor Networks (WSN) is a hybrid type of network where data sensed by the sensors is not collected continuously by the sink. Data has to be secured by every node until the next visit of the mobile sink. This inability to communicate with sink might be for reasons such as: limited transmission ranges, power constraints or signal propagation problems. The concept of WSNs with a mobile sink looks realistic if we consider the environments where the sensing field is too far from the base station and sending data through intermediate nodes may result in weakening the security (e.g., intermediate nodes may modify the data) or increase the energy consumption of the nodes close to the base station. In normal multi-hop Wireless Sensor Networks, power of the nodes placed near the sink will be depleted earlier than the other nodes. This is because all the nodes have to transmit the data to the sink through the nodes placed near the sink. An WSN can be used to save the battery of these nodes and as a result increase the lifetime of the network Unattended environments as mentioned in include sensor networks for monitoring sound and vibration produced by troop movement, airborne sensor networks for tracking enemy aircrafts, LAN droids which retain information until soldiers move close to the network, sensor networks for monitoring nuclear emissions, national parks for discharge and illicit cultivation, etc. In many real world applications, critical data is collected and stored in the unattended nodes in hostile environments. The data should be accumulated until the next visit of the sink. The unattended nature of the network and the lack of tamper resistant hardware increase the susceptibility of attacks over the data collected by the sensors. Since the WSN scenario is different from the traditional WSN's, defense solutions from WSN security literature are not suitable for coping with a mobile adversary in WSN's. The sensors battery power is more limited compared to the battery power of the nodes in MANET's and hence the security protocols for MANETs are not effective for WSNs.

Data Aggregation Process

Data aggregation needs should be taken into account to ensure data protection (also called data survivability) in these sensors at the time of design. Distributed data collection schemes are preferable over centralized schemes, because centralized schemes are prone to single point failure. Data gathering is defined as the systematic collection of sensed data from multiple sensors to be eventually transmitted to the base station for processing. Since sensor nodes are energy constrained, it is inefficient for all the sensors to transmit the data directly to the base station. Data generated from neighboring sensors is often redundant and highly correlated. In addition, the amount of data generated in large sensor networks is usually enormous for the base station to process. Hence, need methods for combining data into high quality information at the sensors or intermediate nodes which can reduce the number of packets transmitted to the base station resulting in conservation of energy and bandwidth. This can be accomplished by data aggregation.

2. MOTIVATION

There is a need in the current state of mobile sensor platform technology to reduce their energy consumption. Numerous low-cost mobile sensor prototypes such as Packbot, Robomote are now available. Their manufacturing cost is comparable to that of typical static sensor platforms. As a result, they can be massively deployed in a network and used in a disposable manner. This approach takes advantage of this capability by assuming that there isa large number of mobile relay nodes. On the other hand, due to low manufacturing cost, existing mobile sensor platforms are typically powered by batteries and only capable of limited mobility. Consistent with this constraint, this approach only requires simple motions of mobile relays, one-shot relocation to designated positions after deployment. Compared with this approach, existing mobility approaches (such as mobile base station and data mule) typically assume a small number of powerful mobile nodes, which does not exploit the availability of massive low-cost mobile nodes.

2.1 objectives

 To minimize the total energy consumed by both mobility of relays and wireless transmission in data-intensive WSN.
 To compare different initial tree building strategies and propose an optimal tree construction strategies for static nodes with no mobility.
 To improve the tree topology by adding new nodes.
To conduct extensive simulations based on realistic energy models obtained from existing mobile sensor platform.
 To reduce energy consumption compared to the best existing solution.

2.2 scope of work

In the next generation of wireless communication systems, there will be a need for the rapid deployment of independent mobile users. Significant examples include establishing survivable, efficient, dynamic communication for emergency/rescue operations, disaster relief efforts, and military networks. Such network scenarios cannot rely on centralized and organized connectivity, and can be conceived as applications of Mobile sensor Networks. A sensor network is an autonomous collection of mobile users that communicate over relatively bandwidth constrained wireless links. Since the nodes are mobile, the network topology may change rapidly and unpredictably overtime. In such networks this approach can work out.

3. LITERATURE SURVEY

We reviewed different approaches, mobile base stations, data mules, and mobile relays that use mobility to reduce energy consumption in wireless sensor networks. We have also review cluster based routing scheme, data transmission method on clustering. A mobile base station moves around the network and collects data from the nodes. In some work, all nodes are always performing multiple hop transmissions to the base station, and the goal is to rotate which nodes are close to the base station in order to balance the transmission load. In other work, nodes only transmit to the base station when it is close to them (or a neighbor). The goal is to compute a mobility path to collect data from visited nodes before those nodes suffer buffer overflows. In several rendezvous based data collection algorithms are proposed, where the mobile base station only visits a selected set of nodes referred to as rendezvous points within a deadline and the rendezvous points buffer the data from sources. We use the mobile relay approach in this work. Goldenberg et al. showed that an iterative mobility algorithm where each relay node moves to the midpoint of its neighbors converges on the optimal solution for a single routing path. However, they do not account for the cost of moving the relay nodes. Mobile nodes decide to move only when moving is beneficial, but the only position considered is the midpoint of neighbors.

4. PROPOSED SYSTEM ANALYSIS AND DESIGN

4.1 problem definition

In the existing system the movement cost of mobile nodes is not accounted for in the total network energy consumption. Instead, mobile nodes are often assumed to have replenished energy supplies. Second issue was that the complex motion planning of mobile nodes is often assumed in existing solutions which introduces significant design complexity and manufacturing costs. So here we are proposing new technique to use low-cost disposable mobile relays to reduce the energy consumption of data-intensive WSNs. Different from previous work, our approach does not require complex motion planning of mobile nodes, and hence can be implemented on a number of low-cost mobile sensor platforms. Moreover, we integrate the energy consumption due to both mobility and wireless transmissions into a holistic optimization framework. The optimal relay configuration is shown to depend on both the positions of nodes and the amount of data to be sent. We develop two algorithms that iteratively refine the configuration of mobile relays and converge to the optimal solution. These algorithms have efficient distributed implementations that do not require explicit synchronization.

4.2 System Architecture

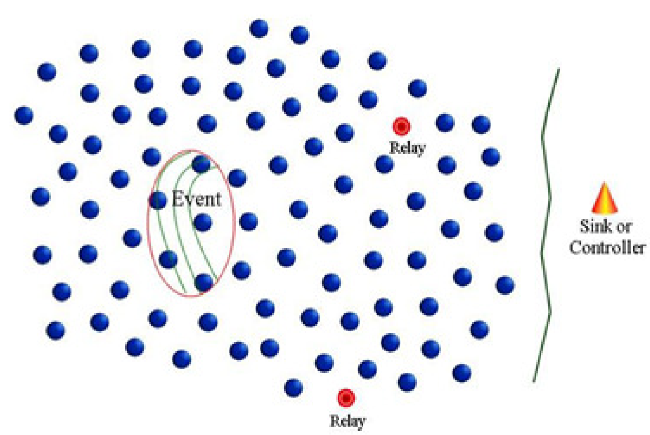

Figure 1: System Architecture

If we look into the diagram it shows how mobile relays are works. Mobile nodes may also be used as relays that forward data from source nodes (data collected by sensor node) to the base station. Here event means data collected by sensors, relay move from one location to other location and act as intermediate node and send collected data to base station.

In, mobile relay, the mobile access point (Mobile relay) traverses the network and collects the sensing information from the individual sensor nodes. The major advantage of the SENMA architecture is that it ensures a line of sight path to the access point within the power range of the sensor nodes, allowing the information to be conveyed without routing. This feature makes it a resilient, scalable and energy efficient architecture for wireless sensor networks. In many cases, due to bandwidth and energy limitations, the sensors quantize their sensing result into a single bit. The mobile relay collects data from sensor node and delivers to base station. we use low-cost disposable mobile relays to reduce the total energy consumption of data-intensive
WSNs. Different from mobile base station or data mules, mobile relays do not transport data; instead, they move to different locations and then remain stationary to forward data along the paths from the sources to the base station. Thus, the communication delays can be significantly reduced compared with using mobile sinks or data mules. Moreover, each mobile node performs a single relocation unlike other approaches which require repeated relocations.
The data aggregation is a technique used to solve the implosion and overlap problems in data centric routing. Data coming from multiple sensor nodes are aggregated as if they are about the same attribute of the phenomenon when they reach the same routing node on the way back to the sink. Data aggregation is a widely used technique in wireless sensor networks. The security issues, data confidentiality and integrity, in data aggregation become vital when the sensor network is deployed in a hostile environment. Data aggregation is a process of aggregating the sensor data using aggregation approaches.

4.3 Working methodology

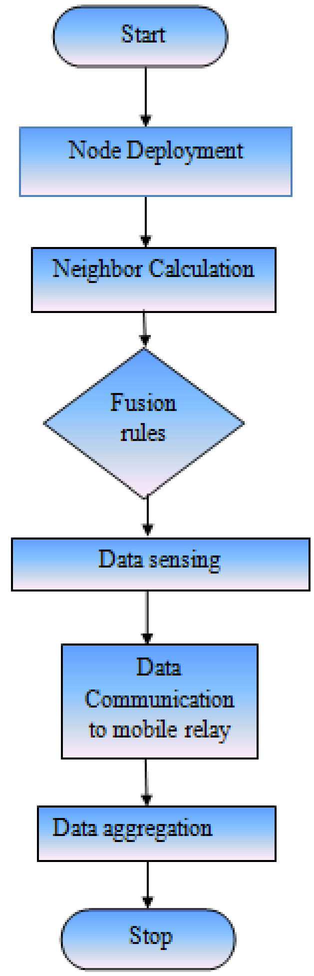

Figure 2: Data Flow Diagram of data aggregation process

4.4 Algorithm for Computing Optimal Position of a Relay Node

Given a network containing one or more static source nodes that store data gathered by other nodes, a number of mobile relay nodes and a static sink, we want to find a directed routing tree from the sources to the sink as well as the optimal positions of the mobile nodes in the tree in order to minimize the total energy consumed by transmitting data from the source(s) to the sink and the energy consumed by relocating the mobile relays. The source nodes in our problem formulation serve as storage points which cache the data gathered by other nodes and periodically transmit to the sink, in response to user queries.

Here mi is defined, which we compute later, to be the weight of node si which is equal to the total number of bits to be transmitted by node si. Define a configuration (E;U) as a pair of two sets: E, a set of directed arcs (si; sj) that represent the directed tree in which all sources are leaves and the sink is the root and U, a list of locations (u1; . . . ; un) where ui is the transmission position for node si for 1<=i<= n. The cost of a configuration (E;U) is given by:

$$c(\langle E,U\rangle) = \sum_{(s_i,s_j)\in E} am_i + b\|u_i - u_j\|^2 m_i + k\|o_i - u_i\|.$$

Algorithm:

Step 1: when transferring little data, the optimal configuration is to use only some relay nodes at their original positions.
Step 2: if amount of data transferred increases then go to step 3
Step 3: the topology may change by adding new relay nodes, then go to step 4
Step 4: the topology may change by changing which edges are used, then go to step 5
Step 5: the relay nodes may move closer together, else
Step 6: restrictions such as no mobility for certain relay nodes or
Step 7: it must use a fixed routing tree.

5. PROPOSED SYSTEM

Proposed Methodology has been divided in 6 Modules:-

1) Network creation Module (wireless sensor networks)
2) Optimal mobile relay configuration
3) Mobile sink &source nodes
4) Routing tree optimization
5) Energy optimization and secret sharing random propagation
6) Performance comparison

1) Network creation Module (wireless sensor networks)

In this module first we deploy the network which composed of many small nodes deployed in an ad hoc fashion. Most communication will be between nodes as peers, rather than to a single base station. Nodes must self-configure. Dedicate to a single application or a few collaborative applications. Involves in-network processing to reduce traffic and thereby increase the life-time. This implies that data will be processed as whole messages at a time in store-and-forward fashion. Hence packet or fragment-level interleaving from multiple sources only delays overall latency. Applications will have long idle periods and can tolerate some latency.

2) Optimal mobile relay configuration

The network consists of mobile relay nodes along with static base station and data sources. Relay nodes do not transport data; instead, they move to different locations to decrease the transmission costs. Mobile relay approach is used in this work. It showed that an iterative mobility algorithm where each relay node moves to the midpoint of its neighbors converges on the optimal solution for a single routing path. However, they do not account for the cost of moving the relay nodes. In mobile nodes decide to move only when moving is beneficial, but the only position considered is the midpoint of neighbors.

3) Mobile sink & Source nodes

The sink is the point of contact for users of the sensor network. Each time the sink receives a question from a user, it first translates the question into multiple queries and then disseminates the queries to the corresponding mobile relay, which process the queries based on their data and return the query results to the sink. The sink unifies the query results from multiple storage nodes into the final answer and sends it back to the user.

The source nodes in this problem formulation serve as storage points which cache the data gathered by other nodes and periodically transmit to the sink, in response to user queries. Such network architecture is consistent with the design of storage centric sensor networks. This problem formulation also considers the initial positions of nodes and the amount of data that needs to be transmitted from each storage node to the sink.

4) Routing tree optimization

Here it is considered the sub problem of finding the optimal positions of relay nodes for a routing tree given that the topology is fixed. Assumed that the topology is a directed tree in which the leaves are sources and the root is the sink. Also assumed that separate messages cannot be compressed or merged; that is, if two distinct messages of lengths m1 and m2 use the same link (si, sj) on the path from a source to a sink, the total number of bits that must traverse link (si, sj) is m1 + m2.

5) Energy Optimization and Secret Sharing Random Propagation

In this module, it is focused on reducing the total energy consumption due to transmissions and mobility. Such a holistic objective of energy conservation is motivated by the fact that mobile relays act the same as static forwarding nodes after movement. Here proposed using low-cost disposable mobile relays to reduce the energy consumption of data-intensive WSNs.

In this section, the problem of deciding the parameters for secret sharing (M) and random propagation (N) to achieve a desired security performance is considered. To obtain the maximum protection of the information, the threshold parameter should be set as T = M. Then, increasing the number of propagation steps (N) and increasing the number of shares a packet is broken into (M) has a similar effect on reducing the message interception probability.
Specifically, to achieve a given P(max) S for a packet, we could either break the packet into more shares but restrict the random propagation of these shares within a smaller range, or

break the packet into fewer shares but randomly propagate these shares into a larger range. Therefore, when the security performance is concerned, a tradeoff relationship exists between the parameters M and P.

6) Performance Comparison

In this module the performance is analyzed and compared through graph. The parameters used for analysis are energy consumption, power, delay, PDR, greedy routing, hope based, centralized and distributed on basis of time. Optimal mobile relay configuration networks uses routing topology based on power-law for searching. The performance comparison is done to compare the searching efficiency of energy consumption.

6. IMPLEMENTATION

We consider a large scale, uniformly distributed sensor network. Nodes in the network communicate with each other via radio links. We assume the whole sensor network is connected, which is achieved by deploying sensors densely. We also assume sensor nodes are awake when data gathering process initiates.

We use NS2 is an open-source event-driven simulator designed specifically for research in computer communication networks. NS2 has continuously gained tremendous interest from industry, academia, and government. Having been under constant investigation and enhancement for years, NS2 now contains modules for numerous network components such as routing, transport layer protocol, application, etc. To investigate network performance, researchers can simply use an easy-to use scripting language to configure a network, and observe results generated by NS2. Undoubtedly, NS2 has become the most widely used open source network simulator, and one of the most widely used network simulators.

To implement this concept smoothly, it need to have one of the various versions of windows operating system which can be XP or onwards and need to install the NETWORK SIMULATOR version -2.32 .Number of mobile nodes used are 51, set in the topology of 3000*2000(m) area. Routing protocol used is ARQ(Automatic repeat request). Traffic used is CBR (Constant Bit Rate).Simulation time is set to 30(s).The different simulation parameters used in this methodology is as follows.

PARAMETER	TYPE
Channel	Wireless Channel
Model	Propagation/Two Ray Ground
Network Interface	Wireless Physical Interface
MAC	IEEE 802.11
Interface Queue	Queue/ Drop Tail/ Pre-Queue
Layer	Link Layer
Antenna Model	Antenna/ Omni Antenna
Routing Protocol	Automatic Repeat Request(ARQ)
Number Of Sensor Nodes	51
Maximum Packet In Ifq	50
X Dimension Of Topography	3000
Y Dimension Of Topography	2000
Time Of Simulation End	30(S)

Table 1: Simulation Parameters

To implement this methodology the operating system used is fedora 8 OS. Then network simulator 2.32 is installed in fedora OS .Then write TCl script is written and save as code.tcl. After that code.tcl file is run, it will create out.tr (trace file) Out.nam (animator file)And performance values will store in other files. To plot graph, there is one utility in ns2 called xgraph. The file created will be given as input to this xgraph file_name1, file_name2. It will plot comparison graph between file_name1 and file_name2.

For execution of our system we run ns code.tcl file. Once it has started executing, all other files will be created. After that we run the animator file nam Out.nam so that the process of execution will be shown on screen. i.e. how nodes are communicating and sending data to base station. When u run code.tcl file window shows event of data sense occurred, that data it send to base station 25 by mobile relays. Same things occurred repeatedly whenever data collection (sensing of data occurred) that data send to base station through mobile relay with different source nodes.

After running code.tcl file, we run nam Out.nam i.e. animator for execution of running scenario of animation the output screen will look like below. Network formation process started and all movements are completed before any transmission begins.

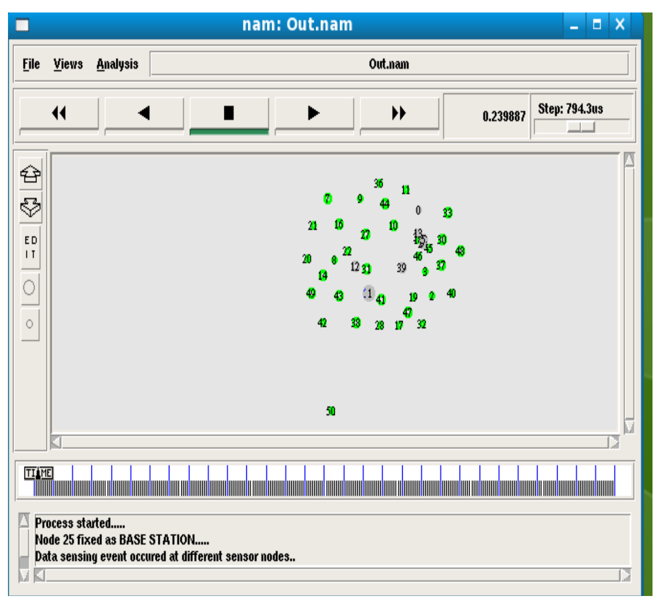

Figure 3: Display of Node Deployment

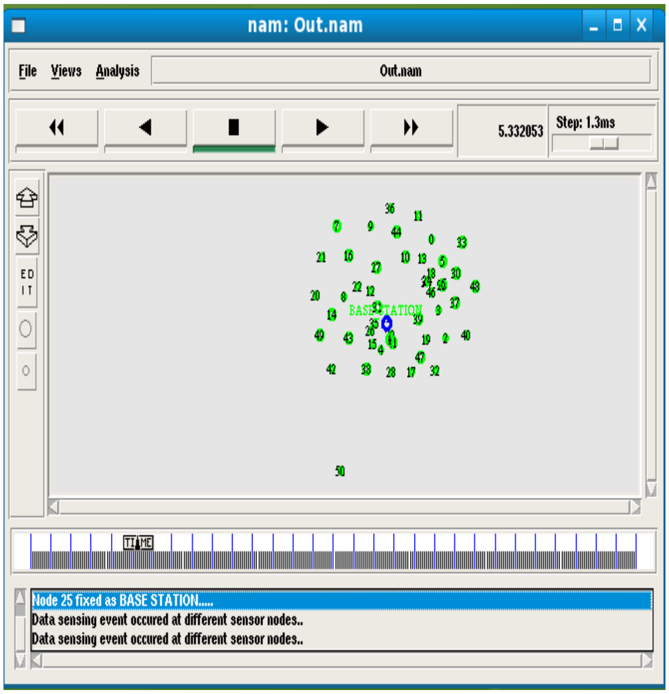

Figure 4: Display of Creation of Base Station

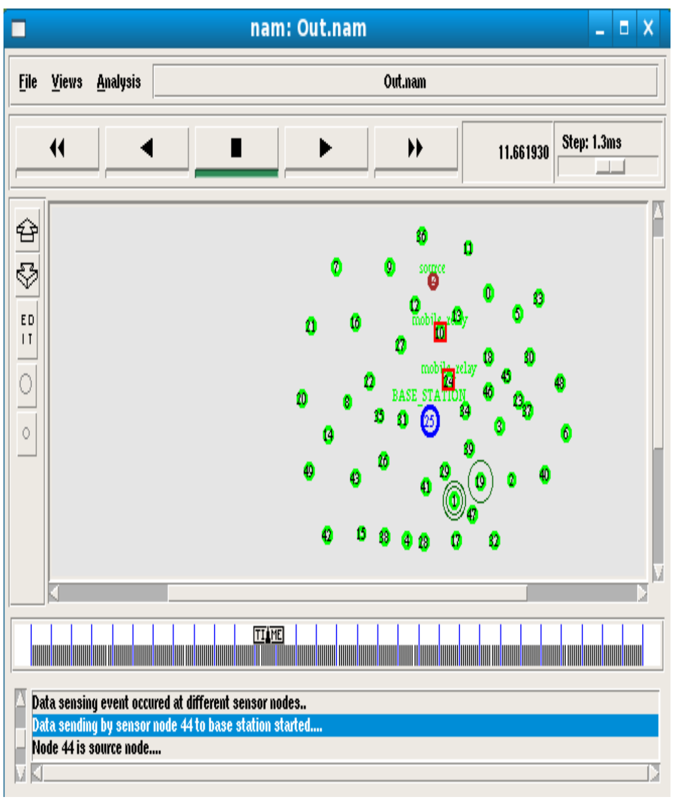

Figure 5: Display of Creation of Mobile Node

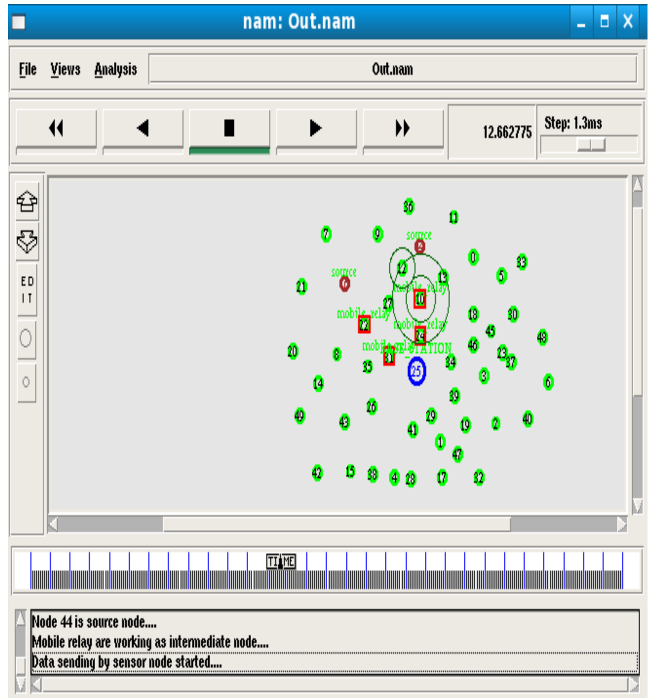

Figure 6: Data transmission from source to sink

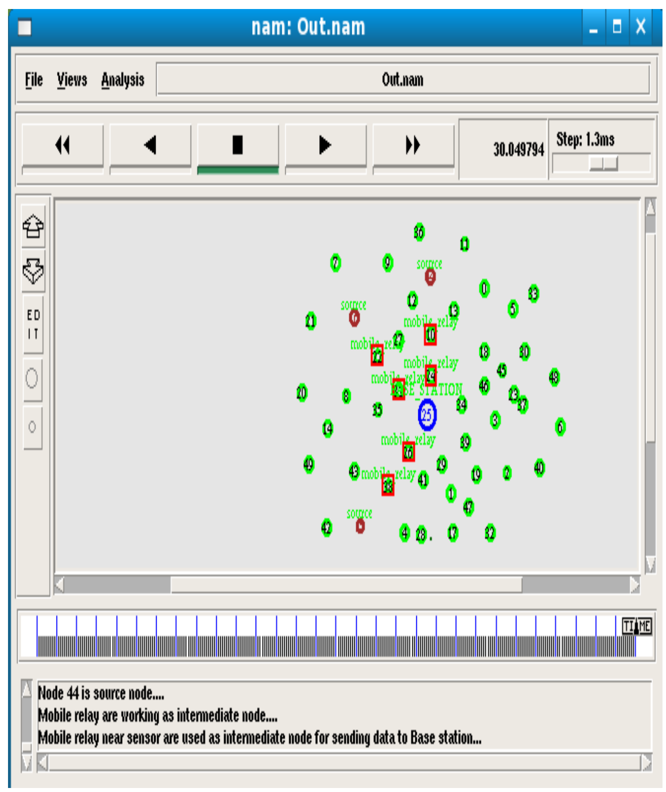

Figure 7: Process completion of data transmission

7. RESULT ANALYSIS

The performance of wireless sensor network is dependent on four factors namely throughput, packet drop, average delay and packet delivery ratio (PDR). The graphical representation of these factors shows how energy is minimized using these four parameters with respect to time constraint. In the graphs below the Y line shows the evaluating parameters i.e. throughput, packet drop, average delay and packet delivery ratio (PDR). And X line shows time.

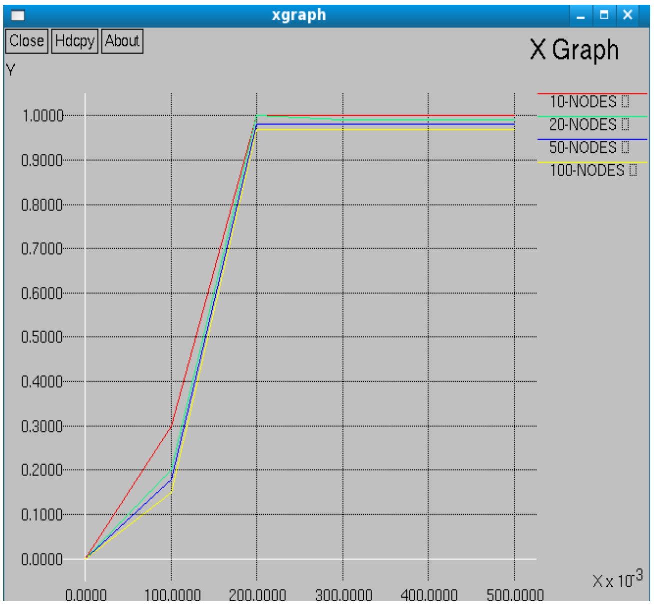

Figure 8: Graph Shows Comparison of PDR With Respect To Time

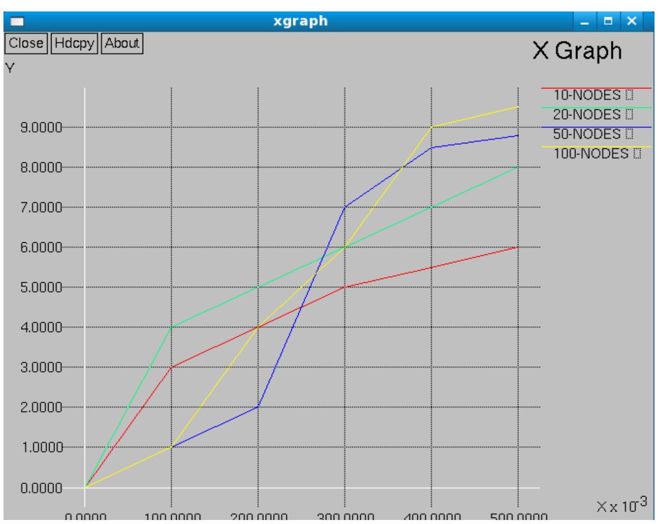

Figure 9: Graph Shows Comparison of Average Delay With Respect To Time

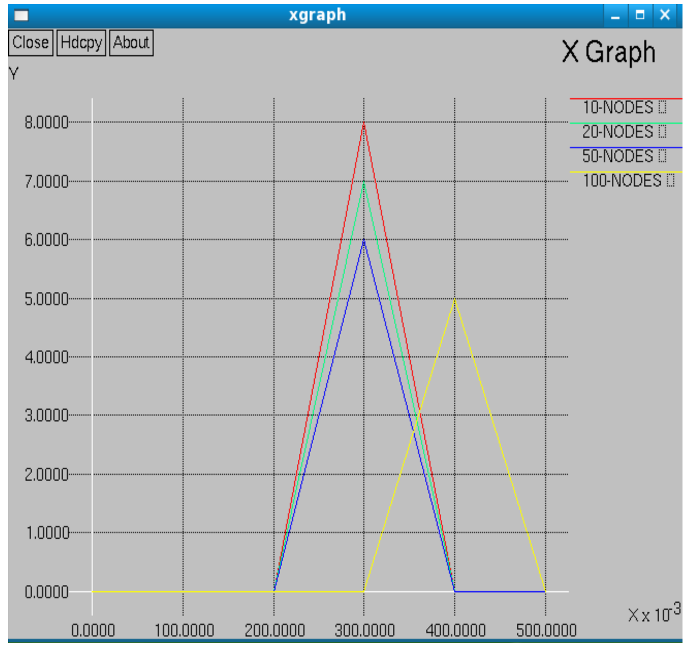

Figure 10: Graph Shows Comparison of Packet Drops

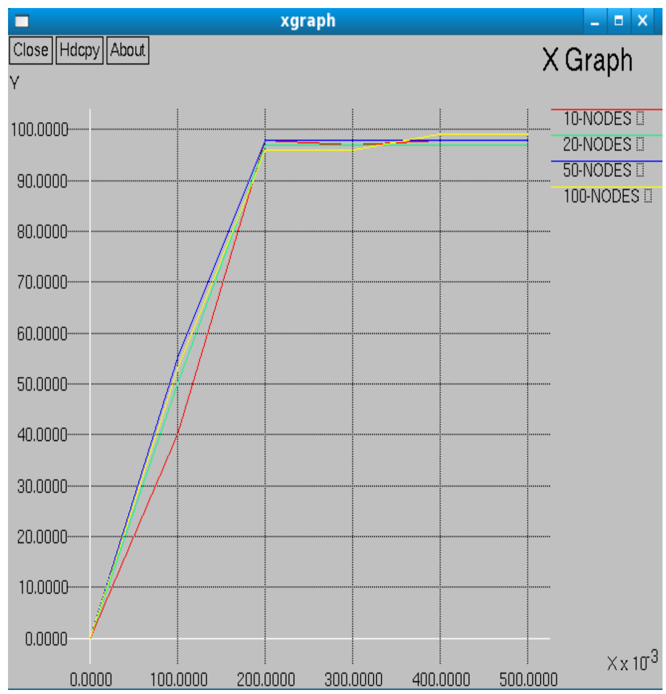

Figure 11: Graph Shows comparison Of Throughput

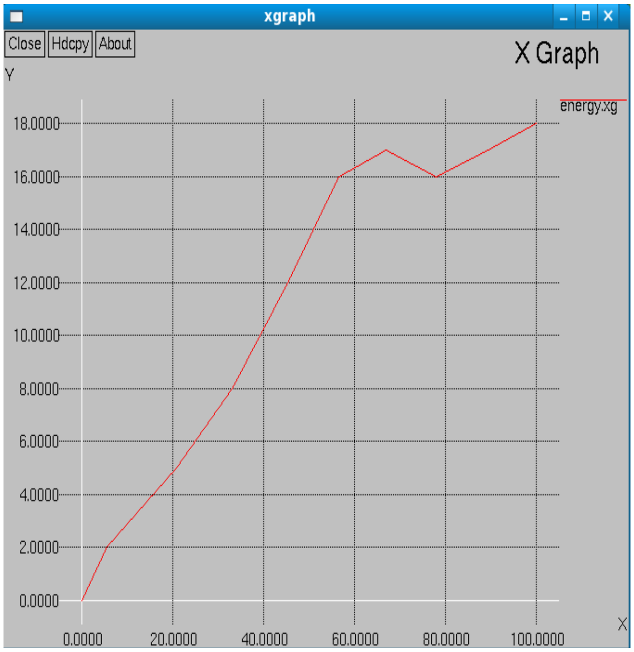

Figure 12: Graph Shows comparison Between Energy Consumption

This is how the result analysis of this proposed methodology is done by taking into account the parameters performance evaluation of wireless sensor network.

8. CONCLUSION

In this paper, we can conclude that a holistic approach to minimize the total energy consumed by both mobility of relays and wireless transmissions is achieved. It developed an iterative approach to compute the optimal positions of relay nodes that can be implemented in a centralized or distributed fashion. This allows to potentially extending this approach to handle additional constraints on individual nodes such as low energy levels or mobility restrictions due to application requirements.

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