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Optimal Placement of Multisinks in Wireless Sensor Network for Lifetime Improvement Network

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ABSTRACT—sensor nodes are powered by batteries and proper energy conservation is needed to prolong the lifetime of the sensors. This work proposes an approach for improving energy-efficiency and thus increasing network lifetime in wireless sensor network (wsn) using a logical energy tree (let). In our scheme, let is constructed using the remaining available energy in each node. Multiple sink nodes are placed in sensor network and routing of packets from sensor nodes is done using let to the centralized sink or to the closest sink. Multiple sinks are placed in a optimum manner such the number of hops for transmission is reduced and due to it the life time of the network is increased.
INDEX TERMS—centralized sinkenergy efficiency, wireless sensor networks, energy, lifetime, efficiency.

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I. INTRODUCTION

WSN are applied in many applications like tsunami detection, ocean boarding alarming for fisherman. Typical WSN consist of nodes connected through wireless infrastructure. The nodes scattered with the objective to sense some environment parameters and route these parameters to base station to realize application logic. The sensors are battery powered and energy depletes during the operation of nodes. At one point of time sensors fails to operate due to very low or no battery energy. In most cases sensors are deployed in unattended environment and it may be costly or not possible to replace the sensor nodes. This necessitates prudent use of energy in the nodes so that longevity of network increases.

Wireless Sensor Networks (WSN) consists of spatially distributed autonomous sensor nodes which are organized into a cooperative network.

Sensor node is a ultra small power limited device with following four main components.

- Sensing component
- Communication component
- Power component
- Control component

Wireless sensor networks may comprise of numerous different types of sensors like low sampling rate, seismic, magnetic, thermal, visual, infrared, radar, and acoustic, which are clever to monitor a wide range of ambient situations. Sensor nodes are used for constant sensing, event ID, event detection & local control of actuators. The applications of wireless sensor network mainly include health, military, environmental, home, & other commercial areas.

- Military Applications
- Health Applications
- Environmental Applications
- Home Applications
- Commercial Applications
- Area monitoring
- Health care monitoring
- Environmental/Earth sensing
- Air pollution monitoring
- Forest fire detection
- Landslide detection
- Water quality monitoring
- Industrial monitoring

Sensing component consists of sensors which sense parameters like temperature, humidity and moisture etc. depending on the application for which it is deployed. Communication component consists of transmitters and receivers for handling data from other devices. Power component consists of battery which supplies energy to rest of the components. Control components consist of programmable microcontroller which runs the code to control the sensors and communication components.

As the node energy depletes; it fails at some point of time, communication holes occur in sensor network. Communication holes are the major problem for multi hop transmission routing model used in wireless sensor network. Recharging the battery is not a viable option in case of unattended environment.

II. RELATED WORK

Researchers in wireless sensor networks (WSN), have given deep attention to large scale integration and energy-efficiency (energy consumption). Energy-efficient solutions can conserve valuable sensor-node energy. This is one of the main critical challenges that WSNs face, which plays a fundamental part in determining the lifetime of the network. Although, there are many WSN protocols, clustering based hierarchal routing protocols are given more consideration because of their improve scalability. In particular, sensors are battery-powered, often limiting available energy, which is not changeable in most of the situations. One of the most common energy-efficiency sensor networks protocols is Low Energy Adaptive Clustering Hierarchy (LEACH) as source. In this paper, CH-leach is proposed . The evaluation was based on the most critical metrics in WSNs, such as: energy-efficiency (energy consumption), and network lifetime. The evaluation and comparison with existing solutions show that our proposed CH-leach exhibits a reduction in energy consumption over LEACH and DEEC. While the overall network lifetime of CH-leach is improved 91% and 43% more than LEACH and DEEC protocols.Wireless Sensor Network (WSN) are of paramount significance since they are responsible for maintaining the routes in the network, data forwarding, and ensuring reliable multi-hop communication. The main requirement of a wireless sensor network is to prolong network energy efficiency and lifetime. Researchers have developed protocols Low Energy Adaptive

Clustering Hierarchy (LEACH) and Power-Efficient Gathering in Sensor Information Systems (PEGASIS) for reducing energy consumption in the network. However, the existing routing

protocols experience many shortcomings with respect to energy and power consumption. LEACH features the dynamicity but has limitations due to its cluster-based architecture, while PEGASIS

overcomes the limitations of LEACH but lacks dynamicity. In this paper, we introduce PEGASIS LEACH (P-LEACH), a near optimal cluster-based chain protocol that is an improvement over

PEGASIS and LEACH both. This protocol uses an energy efficient routing algorithm to transfer the data in WSN. To validate the energy effectiveness of P-LEACH, Network Simulator (NS2) is used to simulate the performance.

In a typical wirelessly powered sensor network (WPSN), wireless chargers provide energy to sensor nodes by using wireless energy transfer (WET). The chargers can greatly improve the lifetime of a WPSN using energy beamforming by a proper charging scheduling of energy beams. However, the supplied energy still may not meet the demand of the energy of the sensor nodes. This issue can be alleviated by deploying redundant sensor nodes, which not only increase the total harvested energy, but also decrease the energy consumption per node provided that an efficient scheduling of the sleep/awake of the nodes is performed. Such a problem of joint optimal

sensor deployment, WET scheduling, and node activation is posed and investigated in this paper. The problem is an integer optimization that is challenging due to the binary decision variables and non-linear constraints. Based on the analysis of the necessary condition such that the WPSN be immortal, we decouple the original problem into a node deployment problem and a charging and activation scheduling problem. Then, we propose an algorithm and prove that it achieves the optimal solution under a mild condition. The simulation results show that the proposed algorithm reduces the needed nodes to deploy by approximately 16%, compared to a random-based approach. The simulation also shows if the battery buffers are large enough, the optimality condition will be easy to meet.

The area of Wireless Sensor Networks (WSNs) is an invented automation which is used in recent years to perform multiple tasks in various domains intelligently. The unbalanced

energy dissipation of Sensor Nodes results in the significant reduction of network lifetime which is the main problem in WSNs. Cluster based routing plays an inherent role in overcoming the energy dissipation problem and enhancing their network lifetime. In this paper, a new Energy Aware Cluster Based Multi-hop (EACBM) routing protocol for heterogeneous networks has been proposed which uses both the concept of clustering and multi-hop communication to reduce the energy consumption of SNs. Also Sub-clustering concept is used for those SNs which are not included in any cluster or which are out of the reach of CH. This protocol is implemented and compared with the existing routing protocols (SEP, LEACH, CEEC and LEFCA) in MATLAB and found that it outperforms in terms of stability, network lifetime and gives the better solution for energy efficiency in hierarchical heterogeneous WSNs.

The major concern is on energy-efficient routing in wireless sensor networks. Existing routing schemes assigns energy-related costs and obtain the shortest paths. Maximum achievable lifetime and optimal link cost are low in the existing routing schemes. The best performance is achieved by obtaining the shortest path in distributed routing algorithm. The present distributed shortest path routing network provides best link cost and have maximum lifetime. Heuristic algorithm is developed with low complexity to obtain best performance to provide route selection framework and a bench mark in evaluating the existing routing algorithm energy efficiency.

III. PROPOSED WORK

The proposed system is an extension of LETSSN and LETCSN.

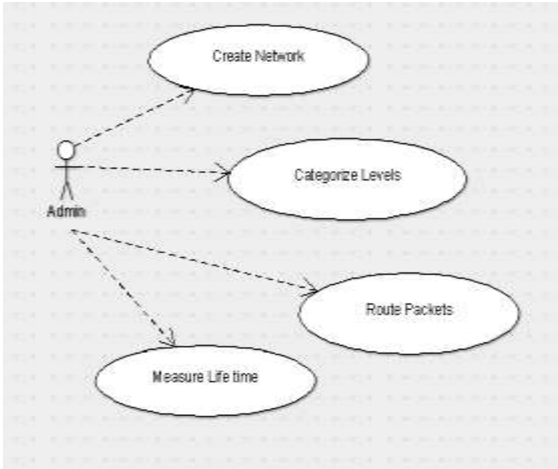
Based on distribution of sensor network, the network is clustered using density based clustering algorithm. The number of cluster is chosen as the number of sinks.

The clustering is done using D-Leach. We present a clustering protocol named Density-based LEACH (D-LEACH) which considers the local node density for selecting nodes joining each cluster, but otherwise operating in a similar fashion to that of LEACH. In D-LEACH, each cluster is organized as in LEACH, i.e. there is a Cluster Head (CH) and many member nodes, whose cluster membership is determined in a distributed manner. However, D-LEACH is different from existing LEACH in selection of the nodes participating in the clusters at each round. D-LEACH dynamically adjusts the probability of each node joining a certain cluster by taking into account the local node density. By preventing transmission of similar or redundant data from all of the nodes in dense cluster, D-LEACH can generally prolong the lifetime of wireless sensor network by reducing the energy consumption of each node. The operation of D-LEACH is separated into three phases: the pre-clustering phase, the setup phase, the steady state phase. . For each round, in the pre-clustering phase, every node computes its own probability of joining a certain cluster in a distributed manner. In the setup phase, the clusters are organized and cluster heads areselected. In the steady state phase, the actual data transfer to the base station takes place. The duration of the steady state phase is longer than the duration of the setup phase in order to minimize overhead.

The sinks are placed at the centroids of the cluster. LET tree is constructed from nodes in the cluster to sink at the cluster. Each node in the cluster sends the data to the sink in that cluster. System architecture is the conceptual design that defines the structure and behavior of a system. An architecture description is a formal description of a system, organized in a way that supports reasoning about the structural properties of the system. It defines the system components or building blocks and provides a plan from which products can be procured, and systems developed, that will work together to implement the overall system.

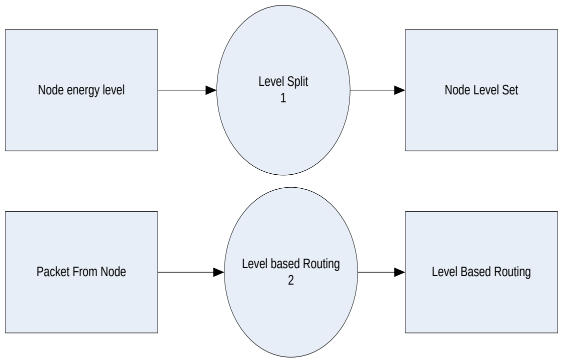
The System architecture is shown below.

A use case diagram is a type of behavioral diagram created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases.



Admin is the user of the system. He can create the network with configurable number of nodes and sink , split the network to various levels. He can route packets from any node and measure the life time of the network.

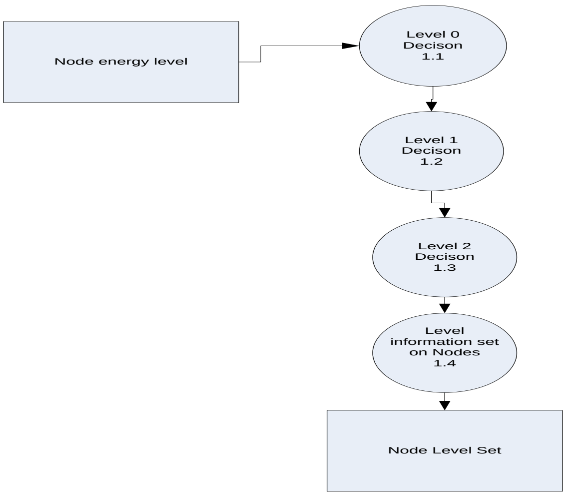
A context-level or level 0 data flow diagram shows the interaction between the system and external agents which act as data sources and data sinks. On the context diagram (also known as the Level 0 DFD) the system's interactions with the outside world are modeled purely in terms of data flows across the system boundary. The context diagram shows the entire system as a single process, and gives no clues as to its internal organization.



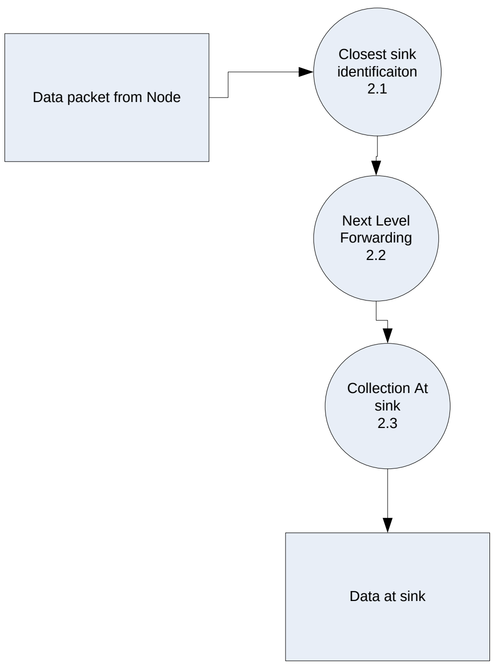
Level Split and Level Based Routing are the two process.

Level Split , splits the network to 3 levels.
Level based routing makes the node to forward data packet to sink.

The Level 1 DFD shows how the system is divided into sub-systems (processes), each of which deals with one or more of the data flows to or from an external agent, and which together provide all of the functionality of the system as a whole. It also identifies internal data stores that must be present in order for the system to do its job, and shows the flow of data between the various parts of the system.
The level split process is split to sub process as below



The level based forwarding process is split to sub process as given below



IV. EXPERIMENTAL ANALYSIS

A region of size 500m ∗ 500m with 120 nodes (one sink node and 119 route notes) randomly distributed throughout is considered in this setup. The network topology was formed based on the most common sink topology (radial distribution around the network). A list of specific simulation environment parameters is provided in Table 1.

No of nodes	120
Simulation area	500m*500 m
Simulator	NS2
Operating System	Ubuntu
Transmission range	400 m

Table 1: Simulation Parameters

Fig 5 shows the comparison of the delivery ratios in the original work and the proposed methodology. In original work the delivery ratio decreases as the number of nodes in the network increases. But in the proposed methodology the delivery ratio increases with the increase in number of nodes.

Fig 6 compares the energy consumption in the original work versus the proposed work. In the proposed work, the energy consumption is lower in comparison with the original work.

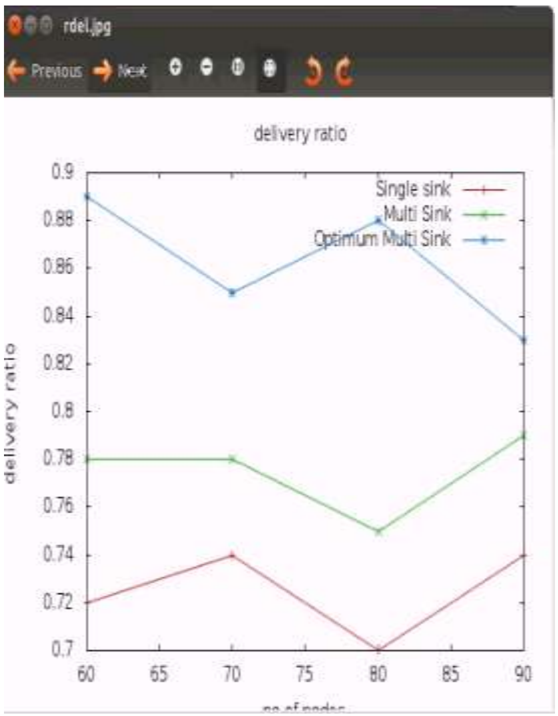


Fig5: Comparison of delivery ratio

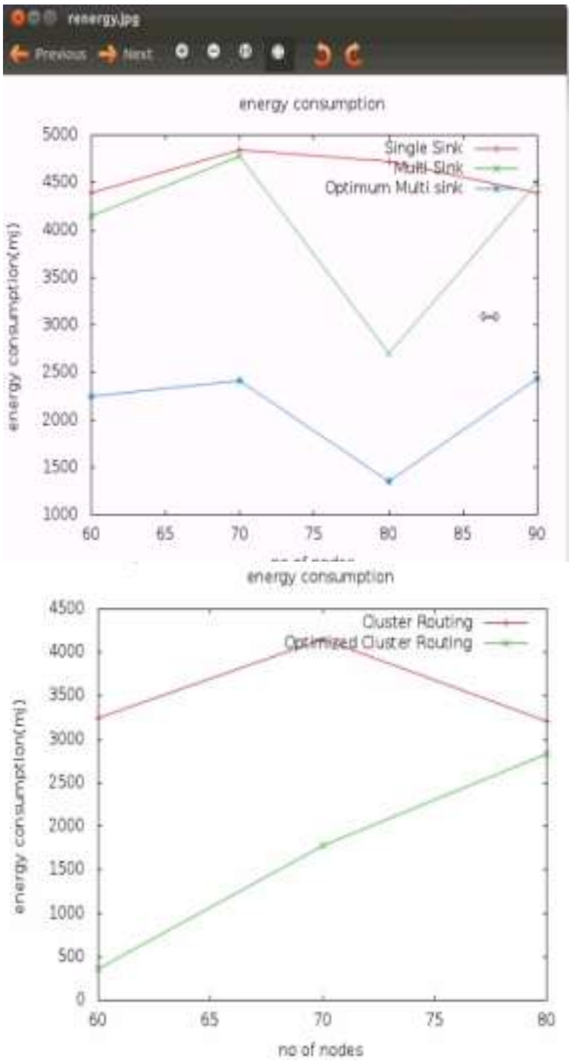


Fig 6: Comparison of energy consumption

V. CONCLUSION

Two routing algorithms, LETCSN and LETSSN are proposed in this work. The improvement of energy efficiency is further attempted by using seven fixed node distribution patterns for WSN. The proposed algorithms, LETCSN and LETSSN were implemented in ns-2. The performances of the LETCSN algorithms were compared with the existing classic routing algorithms PEGASIS, TEEN, LEACH, and LETSSN. Similarly the performances of the LETSSN algorithms were compared with the existing multisink routing algorithms EMCA, LEBDPC, and RPL. The results clearly show that the routing approach, LETSSN maximizes network lifetime for all the node distribution patterns taken into considerations. The performance of LETSSN is further improved by optimum positioning of sink.

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