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# Energy Optimization Routing Protocol for Heterogeneous Sensor Network

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## ABSTRACT

In wireless sensor network, devices or nodes are generally battery powered devices. These nodes have limited amount of initial energy that are consumed at different rates, depending on the power level. Wireless in heterogeneous sensor networks differ from general sensor networks in that the networks have nodes with heterogeneous resources and dissimilar mobility attributes. In this paper we present various energy efficient routing protocol for heterogeneous sensor network

**Keywords :** Wireless Sensor Network, Cluster Head, Homogeneous Sensor Network, Heterogeneous Sensor Network

## I. INTRODUCTION

Wireless sensor network has revolutionized the networking field due to their capabilities to provide data anytime, anywhere and anyhow. The wireless sensor network node being electronic device can only be equipped with limited power source. A wireless Sensor Network (WSN) is composed of a large number of low cost and low power sensor node capable of sensing, local processing and wireless communication capability. The life time of a sensor node is mainly determined by the power supply from finite battery source [2]. Most of the protocols designed for WSNs assume that the sensors have the same capabilities in terms of storage, processing, sensing, and communication. The resulting network is said to be homogeneous. In these types of networks, a pair of sensors would have the same lifetime if they have the same energy consumption rate. Some sensing applications, however, use sensors with different capabilities and accordingly the resulting network is said to be heterogeneous. In the real world, the assumption of homogeneous sensors may not be practical because sensing applications may require heterogeneous sensors in terms of their sensing and communication capabilities in order to enhance network reliability and extend network lifetime [2] Also, even if the sensors are equipped with identical hardware, they may not always have the same communication and sensing models. In fact, at the manufacturing stage, there is no guarantee that two sensors using the same platform have exactly the same physical properties. This taxonomy focuses on heterogeneity at the designing stage, when sensors are designed to have non identical capabilities to meet the specific needs of sensing applications [3].

There are three common type of heterogeneity exist computational heterogeneity or link heterogeneity or Energy heterogeneity. The energy heterogeneity means that the heterogeneous node is line powered, or its battery is replaceable [4].

By User sensor

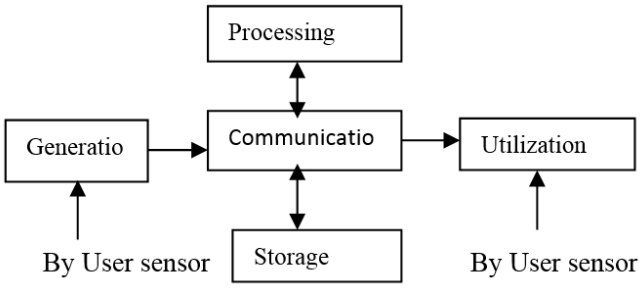
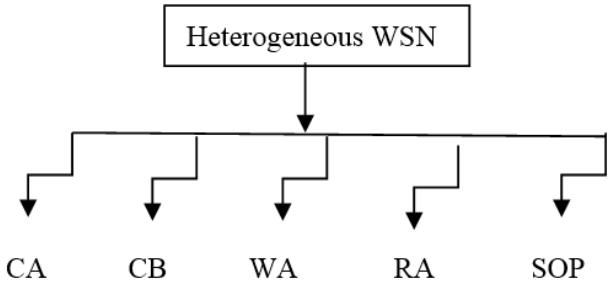



**Fig.1** Basic Structure of Sensor Node

## II. ROUTING IN WIRELSS SENSOR NETWORK

Routing in wireless sensor networks differs from conventional routing in fixed networks in various ways. There is no infrastructure, wireless links are unreliable, sensor nodes may fail and routing protocols have to meet strict energy saving requirements [5].
The hierarchies of Energy Efficient Routing protocol are in Wireless Sensor Network routing protocol are in to groups Homogeneous WSN and Heterogeneous WSN.




CA – Cluster Approach
WA- Weight Assignment
CB - Chain Based Approach
RA- Randomized Approach

### A. Cluster Based Approach

In a hierarchical or clustering network, sensor nodes are organized into clusters, where the cluster members send their data to the cluster heads while the cluster heads serve as relays for transmitting the data to the sink. Cluster Based approach is followed by LEACH, CBR, EDG Low-Energy Adaptive Clustering Hierarchy (LEACH) is a clustering based protocol to collect data from wireless network. In the network, hundreds and thousands of wireless sensors are dispersed that collects and transmit data. Also in these networks cluster heads are elected out of the sensors to transmit the data collected to base station. Also, with the each of the sensor nodes being inexpensive and simple, their power level is low cannot be replaced and because of this, each sensor must take its turn as being a cluster head to make the protocol energy efficient [7].

A cycle LEACH operation is a “Round”, each one round contains the set-up phase and steady phase. During the set-up phase, cluster head generated randomly, the random number is selected in a range between 0 and 1 in each sensor node, if the number selected is smaller than some a threshold T(n), then the node is select as the cluster head. Formulae of T(n) as follows:

Where, p is the percentage of the number of cluster head and the total number of nodes in network, r is the current round number, G is the cluster node set except cluster head of the last 1/p rounds. Then, the cluster head node broadcasts the message of it becoming cluster head to the entire network, each node decides to join which cluster based on the strength of information received, and respond to the corresponding cluster head. Then in the next phase, each node uses the method TDMA to transmit data to the cluster head node, the cluster head sent the fusion data to the sink node. Between the clusters, each cluster competes communication channel with CDMA protocol. After a period of steady phase, the network enters the next round of the cycle again, continuous cycle. The method of cluster head selected randomly avoids excessive consumption of energy, improves the network lifetime, data fusion reduce the traffic

effectively, but the protocol still uses the hop communication, although the transmission delay is small, nodes require a high power communications, expansion is poor, it is not suitable for large-scale networks; even in smaller networks, the nodes farther away from the sink node communicating with each other in high power can lead to a shorter survival time; frequent selecting cluster head will lead to the traffic costing of energy [8].

Sh. Lee et al. suggest a new clustering algorithm CODA [9] in order to mitigate the unbalance of energy depletion caused by different distance from the sink. CODA divides the whole network into a small number of groups based on the distance from the base station and the strategy of routing and each group has its own number of cluster members and member nodes. The farther the distance from the base station, the more clusters are formed in case of single hop with clustering. It shows better performance than applying the same probability to the whole network in terms of the network lifetime and the dissipated energy. The scheme to clustering in terms of the routing strategy.

$$T(n) = \begin{cases} \dfrac{p}{1 - p\left[r \bmod \left(\dfrac{1}{p}\right)\right]} & n \in G \\ 0 & other \end{cases}$$

where Dj is the distance from the sink and smaller index means closer to the sink. K is the number of cluster in each group.

Data gathering [is a major function of many applications in wireless sensor networks (WSNs). In real world applications, it is unrealistic to guarantee all sensors have the same energy because they have different energy consumption. Moreover, sensor redeployment also results in the heterogeneous energy capacities. In this paper, An Effective Data Gathering scheme for heterogeneous energy WSNs (EDGA) is proposed. EDGA achieves a good performance in terms of lifetime by minimizing energy consumption for in-network communications and balancing the energy load. EDGA is based on weighted election probabilities of each node to become a cluster head, which can better handle the heterogeneous energy capacities. Moreover, EDGA adopt a simple but efficient method to solve the area coverage problem in a cluster range, namely intra-cluster coverage. Finally, the simulation results demonstrate that the proposed EDGA significantly outperforms LEACH, HEED in terms of network lifetime and the amount of data gathered in the heterogeneous energy network.

Heterogeneous aware EDGA protocol whose goal is to increase the lifetime and stability of the network in the presence of heterogeneous nodes. Since cluster heads consume more energy than cluster members in receiving sensing data from their member nodes, performing signal processing, and sending the aggregated data to next node or base station, the role of cluster head must be rotated among sensor nodes. EDGA works in rounds as LEACH and EACP [12]] also consider how to optimally select the cluster heads in the heterogonous network.

1. Cluster Heads Selection
2. Selection of Active Member Nodes within Clusters
3. Selection of Active Member Nodes within Clusters
4. Working Phase

In CBRP (Clustered based routing hierarchal routing protocol , a new concept called headset, consist of one active cluster head and some other associate cluster heads with in the cluster [12]. The head set members are responsible for control and management of the network .the head set is responsible to send message to the base station. results shows that this protocol performance better as compare to LEACH in context to energy consumption , frame transmission , and lifetime of the network.

### B. Chain based approach

PEGASIS (Power-Efficient Gathering in Sensor Information Systems), a near optimal chain-based protocol that is an improvement over LEACH. In PEGASIS, each no& communicates only with a close neighbor and takes turns transmitting to the base station, thus reducing the amount of energy spent per round. Simulation results show that PEGASIS performs better than LEACH by about 100 to 300% when 1%, 20%, 50% , and 100% of nodes die for different network sizes and topologies.

This approach wills distribnte the energy load evenly among the sensor nodes in the network. We initially place the nodes randomly in the play field, and therefore, the i -th node is at a random location. The nodes will be organized to form a chain, which can either be accomplished by the sensor nodes themselves using a greedy algorithm starting from some node. Alternatively, the BS can compute this chain and broadcast it to all the sensor nodes.

### C. Randomized approach

Energy aware random asynchronous wakeup (RAW-E) protocol [12], a novel cross layer power management and routing protocol for heterogeneous wireless sensor and actor networks, RAW-E is a distributed, randomized algorithm where nodes make local decision on whether to sleep or to be active based on the energy level of its neighbors primarily result of of RAW-E is the reduction of energy disparity among nodes. Therefore, while the energy reduction is spread uniformly among nodes, the life of network connectivity can be increased. RAW is scalable to change in network size, node type, node density and topology. RAW take advantage of actor nodes, and uses their resources when possible, thus reducing energy consumption of sensor nodes. The performance of this protocol is even good in large network and even scalable with density.

## III. PROPOSED MODEL

These protocols need to be improved further or new protocols should be developed to address. We can extend these protocols to deal with more than three types of nodes and to include more than two level of hierarchy. Important issues/factors that can be explored in these models where the heterogeneity among sensor nodes is not only in their available energy, but also in their processing capabilities and even in energy consumption in their data processing (compression, fusion) etc [1] .

The most interesting research issue regarding such protocols is how to form the clusters so that the energy consumption and contemporary communication metrics such as latency are optimized. The factors affecting cluster formation and cluster-head communication are open issues for future research. Furthermore, various energy conserving protocols have been highlighted. Although many of these protocols look promising, there are still many challenges and issues to be solved. Moreover, the process of data aggregation and fusion among clusters is also an interesting problem to explore. Other possible future research for routing protocols includes the integration of sensor networks with wired networks [14]. Although the performance of these protocols is promising in terms of energy efficiency, further research would be needed to address issues such as quality of service posed by video and imaging sensors and real-time applications.

## IV. CONCLUSION

The development of the ad hoc routing protocols over the last 15 years is an example of one of the most system- atic explorations of a design space in the history of computer science. Although, clearly, newer protocols have built upon the earlier ones, we cannot identify a single “best” protocol. Almost all the

protocols we discussed in this paper have their own sweet spot deployment scenar- ios and performance metric combinations where they out- perform their competitors.

**Table 1 :** Classification of protocols with attributes

| Protocols | Classification | Mobility | Position Awareness | Power Usage | Data Aggregation | Location | QoS | State Complexity | Scalability | Multipath | Query based |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PEGASIS | Hierarchical | Fixed Base Station | No | Max | No | Yes | No | Low | Good | No | No |
| LEACH | Hierarchical | Fixed Base Station | No | Max | Yes | Yes | No | CH | Good | No | No |
| SEP | Hierarchical | Fixed Base Station | No | Max | Yes | Yes | No | CH | Good | No | No |
| SOP | Hierarchical | No | No | N/A | No | No | No | Low | Low | No | No |
| RAW-E | Flat | Yes | Yes | Yes | Yes | Yes | Yes | Low | Good | Yes | Yes |

We have given a comprehensive survey of heterogeneous network in wireless sensor models. Throughout the paper efficient use of energy is given top priority. Various techniques under cluster based approach, chain based approach have been discussed to improve network life time, deployment cost, stability and throughput factors.

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