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# A Review: Growth of Energy Efficient Protocols in WSN

Pardeep Kumar Mall<sup>1</sup>, Sukhwinder Kaur<sup>2</sup>

<sup>1</sup>M tech Student, <sup>2</sup>Assistant Prof., Electronics and Communication Department, IKGPTU Ramgaria Institute of Engineering and Technology, Phagwara, India

**Abstract:** As we know the performance and lifetime of a wireless sensor network depends upon the energy factor that is consumed by the sensors to perform assigned operations. There are various methods or protocols are available in the market, which makes a network capable to perform large operations by consuming a minimal amount of energy. Such protocols are known as energy efficient protocols (EEP). This study represents the generalized concept of wireless sensor network along with various clustering and various energy efficient protocols that are widely used for proper utilization of energy in the network by its sensor nodes. This study also highlights the work of previous years that had been conducted to enhance the efficiency of energy efficient protocols. The review of the work is organized in the conclusion section.

**Keywords:** Wireless Sensor Network, Routing, Clustering, Energy Efficient Protocols, LEACH, DEEC, PEGASIS, TEEN.

## I. INTRODUCTION

Since, wireless is the most trending technologies in the present time, the wireless sensor networks are the peak technologies in this area [1]. Wireless networks as the name implies are those networks that do not employ wires for communication i.e. these communicate through wireless medium. Low power devices often known as nodes are used for communication purposes and these nodes are also responsible for collecting the data from the surroundings [2, 3].

There can be any number of nodes in a network which are responsible for sensing data. The sensors that can be employed in nodes can be any like heat sensor, temperature sensor, pressure sensor, sound sensor etc [4]. the characteristics of the nodes deployed in a network are lower cost and power, smaller in size, offers and supports short-range communication and these nodes are multifunctional as these can be used for processes like routing, sensing, processing etc. these wireless[5] networks are gaining popularity because their applications include various household and commercial applications [6].

The only drawback of these wireless sensor networks is the limited power of the battery that limits its use in various processes like sensing, communication, processing and storage [7]. The recharging of the battery or its replacement is sometimes difficult in wireless sensor networks.

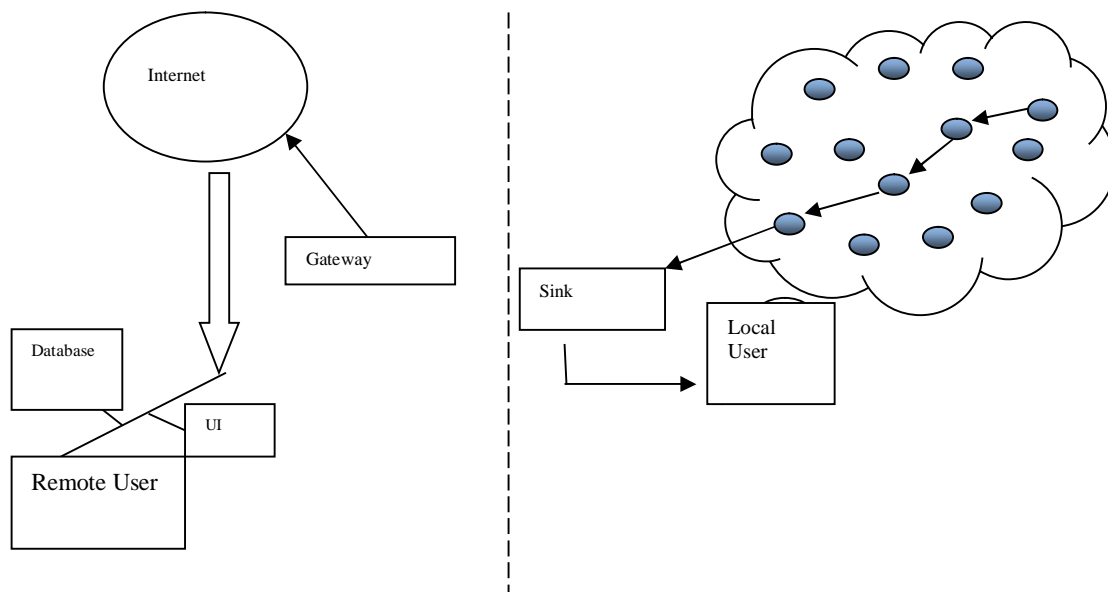


Figure 1 Structure of Wireless Sensor Network

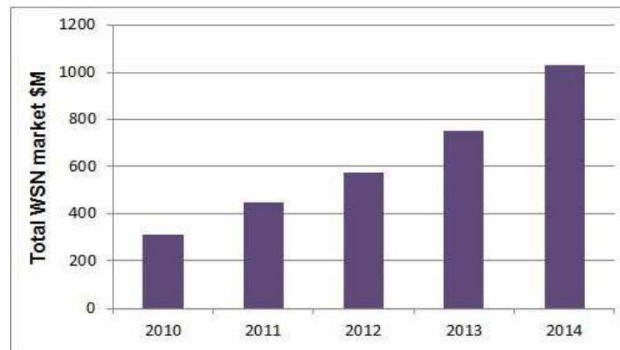


Figure2. Market of WSN during 2010 to 2014 [29]

The above graph depicts the WSN market during 2010 to 2014. The graph represents that in 2014 a drastic increase can be seen in users of WSN as compare to the year 2010.

In the wireless sensor networks, routing plays an important role for sending the data from source to destination [8]. Routing is the process of selecting best path for data transmission [9]. Various protocols have been designed for finding out best path from the available paths. But routing also relies upon the concept of energy consumption of nodes. Each and every node has been allotted with some amount of energy when network is initialized than this amount of energy is utilized by the sensor nodes to perform various processes such as data transmission etc [10]. Therefore a network can only perform effectively if minimal amount of energy is consumed by nodes for data transmission from source to destination [11]. To implement this concept various energy efficient protocols has been developed to elect the best suitable node for cluster heads.

Energy consumption is the most important aspect for designing a efficient wireless sensor network. Finite electrical energy in each sensor node, is defines by the capacity of the onboard battery [12]. Due to size and cost, variations of solar radiance, and constraints imposed by the rechargeable battery. Hence, all design related features of wireless sensor nodes must include facts regarding energy conservation [13]. Other parameters which affect the energy use are sensing and actuation current, which are important for some applications like vibration sensing and gas density sensing.

## II. ENERGY EFFICIENT PROTOCOLS

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The energy efficient protocols have been developed from clustering point of view. Since clustering is the main process which can effects the energy consumption by the nodes of the network [16]. Clustering is a process in which the whole network is sub divided into small parts and these sub division comprises nodes with similar behavior. The energy efficient protocols are as follows;

### A. Leach

LEACH is a clustering protocol which distributes the energy equally to the sensor nodes. It is a self-organized and adaptive protocol as its name suggests [17]. It organizes all the nodes in a local cluster and each and every node among all of the nodes acts as a cluster-head or gateway node. If it elects a cluster head at the starting then the same node have to act as a cluster head throughout the existence of the network, as in previously used clustering algorithms[18], it can be observed that the candidate nodes would die quickly, ending the existence of all nodes that relates to those clusters. .

For that reason this routing protocol has a high energy cluster nodes which is arbitrary so that it can rotate amid all sensor nodes to exhaust the energy of single sensor[19]. Due to its various features like decreased controlled messages, enhancement in resource allocation, re-utilization of bandwidth, saving of proves efficiency for Autonomic Sensor Network which has mobile battery power nodes.

The advantages of this are as follows

- 1) Mostly used protocol due to its less complexity and easy implementation.
- 2) In this the node which is elected as a cluster head once is not eligible to become cluster head again in next round hence this leads to equal load sharing.
- 3) It has caliber to enhance the lifetime or existence of the network because it is an average energy consumption protocol [20].

### B. Heed

HEED (Energy-Efficient Distributed Clustering) is a energy efficient clustering protocol which does not contain any communication overhead so it did not include the efficient allocation of cluster head nodes over the network [21]. Many clustering algorithms are available which creates more uniform clusters at the expense of overhead in cluster formation. HEED uses distributed algorithms which are easy to implement and understand. HEED uses a cluster formation algorithm, in which each node is assigned with a cluster head probability which is the function of their amount of remaining energy and also communication cost which is the function of adjacent node [22]. Cluster head probability is used to decide that whether the sensor node that whether a node can be elected as cluster head or not.

The advantage of HEED is that

- 1) The cluster nodes have no need to maintain the information of all nodes in the network.
- 2) It considers that each node is part of a single cluster heads.

### C. Teen

TEEN stands for Threshold sensitive Energy Efficient sensor Network protocol. It is used for reactive networks. It is an application which senses the temperature [23]. It is more energy efficient protocol as compare to the conventional protocols. To overcome the limitations of LEACH protocol the TEEN protocol is developed. It enhanced version of LEACH protocol. It has various drawbacks that restrict its proficiency in large scale networks [24]. The lacking points are as follows which makes is weak:

- 1) It randomly elect cluster-heads before the events happened, causing unnecessary energy consumption and unbalancing.
- 2) Choosing the cluster-heads without considering their residual energy.
- 3) The cluster-heads transmit data to the sink node directly.

The advantages of TEEN are as defined below-

- a) It reduces the amount of energy utilized for transmitting the data.
- b) It results in enhanced reliability of received data and efficiency of the network.
- c) It is more robust as compare to other protocols.

### D. DEEC

DEEC stands for distributed energy efficient clustering. It is used for heterogeneous wireless sensor network [25]. It evaluates the difference between residual energy of every sensor node by comparing it to the average energy of the network, and then it utilizes a probability function for selecting a cluster head node. The changes in initial energy and residual energy affect the number rounds in the network. The sensor node with high amount of residual energy and initial energy is more suitable for selecting cluster head node as compare to other nodes. DEEC uses the clustering algorithms which can enhance the network lifetime by utilizing a minimum amount of energy. DEEC can gain more effective messages as compare to the classical clustering algorithms. DEEC is more suitable for Multi-level heterogeneous networks.

Following are the advantages of DEEC:

- 1) Unlike other protocol there is no need of having the information of energy of rest of the nodes in each and every round.
- 2) DEEC is most suitable protocol for multi-level heterogeneous wireless networks.

### E. PEGASIS

PEGASIS stands for Power-Efficient Gathering in Sensor Information Systems. It is a chain-based power effective algorithm [26]. It is based on following two parameters i.e. Chaining and Diffusion. It works similarly LEACH. In PEGASIS, each node can act as a leader of the chain and chain is also constructed with the help of greedy algorithm and can install by the sensor nodes. PEGASIS is based on following assumptions:

- 1) Sensor nodes have global knowledge of the network
- 2) All the nodes are stationary
- 3) Nodes have knowledge about the location of all other nodes.

The advantages of PEGASIS over other protocols are as follows:

- a) PEGASIS is an enhanced version of LEACH protocol.
- b) In this protocol the energy is distributed equally to all the sensor nodes so that the nodes can remain in working condition for long period.



### III. RELATED WORK

#### A. Sunita Rani, [1]

In this work it was defined that the wireless sensor network poses all the features of ad hoc networks. In WSN each and every node has a fixed amount of energy which is allowed spend in order to perform data transmission from source to destination. The employed sensor nodes are capable to sense the data from its surroundings such as temperature, vibrations etc. Then this gathered data is transferred to the sink node. In the process of transmission of data node consumes some amount of energy. The lifetime of the network depends upon the amount of energy consumed by the nodes. The protocols are used to minimize the delay in data transmission along with the reduced power consumption and extended lifetime of the network. Example is PEGASIS. PEGASIS follows a chain structure, every chain consist of only one cluster head, it is in charge with every node's receiving and sending messages who belong to this chain, the cluster head consumes large energy and the times of every round increasing. In PEGASIS, saves the energy for WSN and increase the lifetime of the network. The proposed work was about to select the next neighboring node reliably. Some parameters were considered i.e. Distance, Residual Energy and Response time. As the result simulates that PEGASIS leads to the reduction in energy consumption and extended lifetime of the network.

#### B. Lalita Yadav, [15]

In this author defines the LEACH protocol. As WSN is a collection of small swchich are divided into clusters and each node consumes some energy in order to transmit data with cluster heads and sink node. Therefore the lifespan of network lies on the energy consumption of the nodes. Thus protocols are used to minimize the energy consumption and maximize the lifespan of the network. LEACH protocol is used to improve the energy consumption and extends the lifetime by maintaining a balance between these two parameters.

#### C. M. J. Handy, [16]

In this author focuses on a parameters such as reducing the power consumption .for this purpose LEACH protocol is modified. The cluster head algorithm is extended by deterministic component. Lifetime of the network can be enhanced to 30% as depends upon the type of network. Three matrices can be used to define the lifetime of a network FND (First Node Dies), HNA (Half of the Nodes Alive), and LND (Last Node Dies).

#### D. R.Vadivel et al. , [20]

Energy efficient with protected consistent routing protocol towards mobile ad hoc networks was proposed. The remaining energy metric was assessed for providing vigor competence and enhanced reliability. To afford security against malicious spells an operative intercept detection and correction (IDC) algorithm was presented. The IDC algorithm used the remaining energy approximation and traffic inspection. The traffic inspection was carried out through estimating the loss rate at a specific node. When the assessed loss rate at a particular node exceeds than the ordinary loss rate, the nodes intricate would be determined as attacker nodes. Concluded NS2 simulations, the proposed EESRRP protocol was compared with the AODV protocol. With experimental results, it was proved that the proposed EESRRP protocol attains better dependability along with abridged power consumption. Also the simulation results promised the uncovering of malicious nodes and enhanced security.

#### E. D. Yi et al. , [22]

Proposed an amended delay-aware and vigor effective clustered protocol called Hamilton Energy-Efficient Routing Protocol (HEER). HEER procedures cluster in the network initialization phase and relatives associates in every cluster on a Hamilton Path, assembled by using a greedy algorithm, which was using for data transmission persistence. No cluster reformation was obligatory and the followers on the path will take goes to become cluster head. The design consents HEER to save on network management vigor and also equilibrium the load comparing to traditional cluster-based protocols. The algorithms intended in HEER also revenues that it did not agonize long delay and did not necessitate all nodes to have international location information associating with classic chain-based protocols.

### IV. CONCLUSION AND FUTURE SCOPE

After having a review to the section above which defines the traditional work that was conducted by various professionals in the field of wireless sensor network, it is concluded that the whole performance and existence of the network depends upon the energy factor of the network. Various energy efficient routing protocols have been developed which affects the process of electing cluster

head node since the node which act as a cluster head has a vital effect on working of network. This study is specifically conducted for having a review to the existing energy efficient protocols along with their advantages. So in future there is a need to develop such a system which can increase the efficiency and also enhances the lifetime of the network.

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