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# A Review of Wireless Sensor Networks and Clustering Topologies

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***Abstract:*** ***Wireless sensor networks (WSNs) are a combination of wireless sensor nodes, which have computation capabilities with sensing of various physical and environmental conditions. Recently, WSNs have found usage in a number of application areas including medical, defense, surveillance, farming etc. One of the important research aspects in WSN has been towards adequate and effective mechanisms for data forwarding to enhance the energy efficiency in networks. In this paper, a survey of various topologies related to Wireless Sensor Networks has been presented. Also, a review of various existing energy efficient routing protocols has also been presented.***
***Keywords: Wireless Sensor Network, Routing, LEACH.***

## I. INTRODUCTION

Wireless Sensor Nodes involves various sensor nodes to form an extensive system. The sensors can detect ecological conditions like sounds, temperature, weight, course and so on. These sensor nodes communicate with each other or to the base station (control station) after sensing. Such sensor nodes are comprised a compact electronic modules which needs to be small and lightweight [1]. The underlying exploration of WSN was persuaded by the military applications. However, WSN has been progressively been utilized in non-military personnel applications. A sensor node most commonly consists of microprocessor or microcontroller based processing unit, sensing circuitry, a battery and a transceiver. A sensor unit is additionally separated into two sub units which are known as sensors and ADC. The analog signals produced by the sensors depending on the observed phenomenon is converted to digital signals by the ADC and then passed into the processing unit. Handling unit comprises from capacity, which is utilized for briefly capacity of data and passes the data to different hubs to perform detecting task. Handset passes information to different hubs present in the system from the present hub. The power unit comprises of vitality sources, for example, batteries and sunlight based cells [4]. To make sensor nodes versatile, an assemble gadget is utilized which makes the hub versatile to the earth.
Sensor nodes collect the sensed data for a period of time and can send it to the nearest base station themselves through direct delivery. Although this is the most common approach, the use of this method leads to heavy network traffic and as the nodes are limited by energy, this reduces the network's lifetime. The sensor network consists of a sensor field in which the sensor devices or nodes in this field are scattered. Multi-hop techniques and router-based infrastructure can be used to preserve a substantial amount of energy over the network's long run. The dynamic parameters present in this type of network are restricted following few of the parameters that could dynamically change depending on the application:

*A.* Power Availability.
*B.* Nodes Positioning.
*C.* Reachability.
*D.* Type of Task.

Clustering or hierarchical protocols were designed to address issues of energy management in WSNs. The clustering based protocols are based on the concepts that the nearby nodes form a cluster or group of nodes. Each node in the cluster forwards its data packets to an elected node known as cluster head which then forwards it to the base station. This increases the energy

## II. LITERATURE SURVEY

Clustering techniques were developed to address issues of energy management in Wireless Sensor Network. A pioneering work in this regard is the Low Energy Adaptive Clustering Hierarchy (LEACH)[5]. LEACH is a clustering-based protocol that uses randomized local cluster base station selection and rotation also called as cluster heads for transferring data to the sink node, in order to preserve energy evenly between the sensors in the network. Cluster head rotation is also a tool for fault tolerance [1]. The

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sensors organize themselves into clusters to randomly elect themselves as heads in an epoch using a probabilistic method. The LEACH protocol, however, is not heterogeneous in the way that sensors die faster than a more uniform energy setting [10], when there is an energy difference at some threshold between these nodes in the network. A probability-based clustering algorithm was proposed in the Distributed Energy-Efficient Clustering Algorithm (DEEC) [12]. DEEC chooses cluster heads based on information about the relationship between each node's residual energy and the network's average energy. However, this knowledge requires additional energy consumption information to be shared between the sensor nodes. Stable Election Protocol (SEP)[13] is another heterogeneity-aware protocol that does not require sharing of energy knowledge but is based on assigning weighted node election probabilities to be elected cluster head based on their respective energy. This approach ensures that the selection of the cluster head is randomly selected and distributed on the basis of each node's fraction of energy, thus ensuring uniform node energy use. H-DEEC and MH-DEEC [16], two variations of DEEC are the routing protocol for heterogeneous networks has been proposed as energy-conscious adaptive clustering protocols. In H-DEEC, based on initial and residual energy, the network is divided into two parts. Normal nodes choose to be cluster heads and Beta nodes collect data from cluster heads and use multi-hopping to send it to base station. Unlike SEP and DEEC, in a heterogeneous wireless sensor network, H-DEEC and MH-DEEC perform better. Moreover, it also considers the problem of locating base station outside the network.

## III. MATHEMATICAL MODEL OF WSN

In many research on wireless sensor networks, the first order radio model is used. Energy is dissipated while transmitting and receiving data and energy consumption for short-range communication is d2 when propagation is in line of sight and d4 for long-range due to multi-path fading. It works on the measurements of the route and there is constant sensing resulting in a steady volume of data being transmitted to the sink. In an analytical implementation, the following assumptions are considered:

*A.* Base station is fixed: densely deployed and static wireless sensors. There is a predetermined number of clusters for the WSN. They will pass the data on the predefined path in which the cluster heads are numbered according to their distance based on the signal strength received (RSS).

*B.* Some sensors are further away from the base station, which is why the cluster head consumes the d4 energy for direct transmission of l bit data. Thus, data is passed through multiple hops and reaches the base station very close to the base station by cluster

*C.* Links are symmetrical, i.e. the same power level is required for communication between any two nodes. It is considered that there are no modifications in topology. Thus, to transmit a message of length to a distance d, the energy is given as:

$$d_0 = \text{sqrt}(E_{mp}/E_{fs}) \quad (1)$$

if $d<d_0$

$$Et_x(k,d)=E_{elec}*k+E_{mp}*k*d_4 \quad (2)$$

if $d \geq d_0$

$$E_{tx}(k,d)=E_{elec}*k+Emp*k*d_4 \quad (3)$$

Reception Energy:

$$E_{rx}(k)=E_{ele}c*k \quad (4)$$

Where Eelec is the energy dissipated in transmission and reception, Efs and Emp are free space and amplifier enegy respectively.

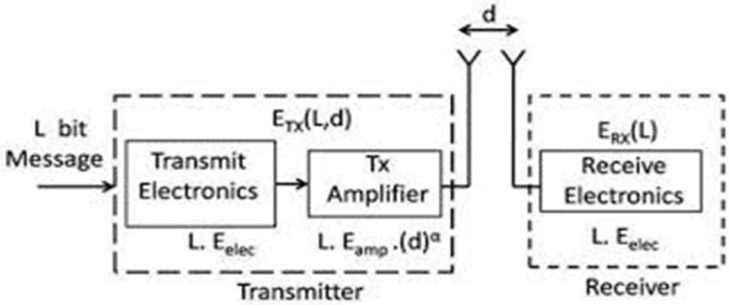


Fig 1: The First order radio model

The diagram above shows a pictorial representation of a radio model of first order. For each data bit transmitted, the transmitter and receiver use the same type of electronic circuitry and therefore their energies are accumulated as 'Eelec'. The nodes of the sensor are therefore symmetrical to one another.

## IV. CONCLUSION

Wireless Sensor Network Technology is an efficient means to provide relatime sensing in a number of applications. The sensor nodes have a compact architecture according to the needs where they are used and are fitred with limited energy resources. Thus efficient utilisation of these resources calls for effecirnt planning of the packet forwarding schemes. In this paper, a review of the various concepts related to WSN has been presented alongwith a brief overview of the various packet forwarding or routing protocols. This study will further be backed up with a novel proposal for clustering in WSN.

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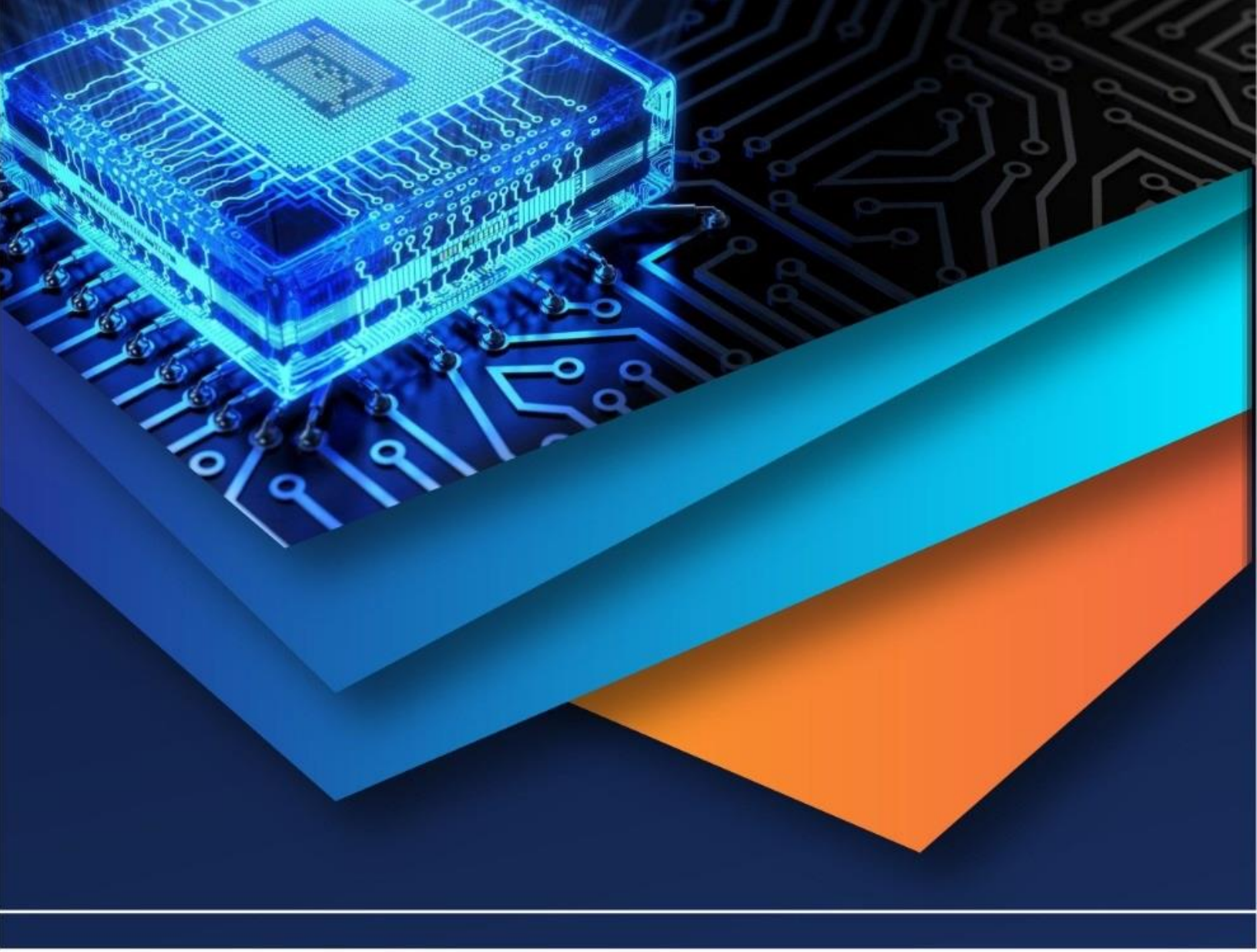

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