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Types Routing Protocols based one Energy Efficiency

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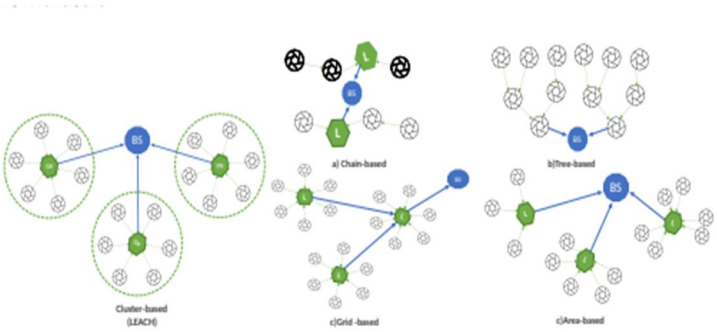
Abstract: ***Wireless sensor networks (WSNs) consist of autonomous sensors distributed in space to monitor physical or environmental conditions such as temperature, sound, and pressure, and to coordinate communications. The information collected reaches its destination through the network infrastructure. Energy-efficient routing protocols are becoming more important because sensor nodes are power-limited devices. Several tiered routing protocols have recently been proposed to minimize power consumption. For example, LEACH is a basic hierarchical routing protocol that uses clustering to achieve energy efficiency. Much research has been done to eliminate the shortcomings and improve the performance of hierarchical routing protocols. WSN hierarchical routing protocols and analyzes the capabilities and performance of existing hierarchical routing protocols. It also compares existing routing protocols, highlights key technical differences, and provides a performance comparison of some LEACH-based routing protocols. Finally, this article highlights the issues and challenges of existing WSN routing protocols. It supports future research on the selection of appropriate research areas and provides guidance on the selection of energy saving methods in the energy efficient design of WSN routing protocols.***
Keywords: wireless sensor network, routing protocols, CSMA, CH, TDMA

I. INTRODUCTION &DISCUSSION

Hierarchical Routing Protocols Heinzelman et al. [56] proposed the first hierarchical routing protocol referred to as LEACH (Low Energy Adaptive Clustering Hierarchy). LEACH proposes a random rotation method to select the node with maximum energy level as the CH, and so uniformly distribute the energy load among the sensors in the network. CHs send advertisement messages to the whole WSN using CSMA. Each sensor node joins the cluster from which it receives the strongest signal. Next, CH schedules TDMA slots for each member in the cluster to send data to it. CH uses aggregation techniques to combine the data received from sensor nodes to save energy and bandwidth, and then this aggregated information is forwarded directly to the BS, i.e., using only one hop, The single hop transmission is the simplest method, but usually it is not suitable for large networks, where multiple hop transmission should be employed. In this case, data follows a multiple hop route across several CHs towards the BS, and so it is essential to use an energy aware routing protocol that avoids unnecessary transmissions and the overload in the nodes close to the BS. techniques can be performed by the CH, (iii) energy intensive operations such as coordination or data reduction are only carried out by the CH, (iv) it enables the powering off of some nodes, typically after sending data to the CH. On the other hand, hierarchical routing also improves network scalability by maintaining a hierarchical topology in the network. as shown in fig.



Different hierarchical routing strategies (BS base station, L leader, CH cluster head).

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LEACH is still the most important and most used basic routing algorithm for WSNs. After 18 years of existence, much attention is still devoted to LEACH by the research community working in the area of routing in WSN. This itself shows its relevancy. In several recent works [1 1–1 3], the authors survey, classify and analyze different versions or improvements of LEACH, also using multi hop transmission. Manjesh war and Agrawal [1] proposed another popular cluster based routing algorithm referred to as Threshold sensitive Energy Efficient sensor Network (TEEN) [1]that has been designed for time critical applications. TEEN combines the architecture based on clustering with the use of a data centric mechanism. Adaptive Periodic TEEN (APTEEN) [1 5] is an enhancement of TEEN where CH broadcasts relevant parameters to the cluster members such as threshold values, TDMA schedule, and maximum time between consecutive reports. Another interesting cluster based routing protocol is Hybrid Energy Efficient Distributed (HEED) [1 6], whereCH election is triggered in given intervals and it is based mainly on residual energy and other parameters as the number of neighbours or the distance to them. A survey recently published by Ullah [1 7] focus on HEED based protocols. Since the relevancy of clusterbased routing, it is common to speak indistinctly of cluster based and hierarchical routing, but strictly speaking, other types of hierarchical structures have been proposed in the literature. Recently, Chan et al. [1 8] survey and compare both LEACH based clustering and these other hierarchical structures, classified into the following categories: (a) chain based, (b) tree based, (c) grid based, and (d) area based, also represented in the In chain based hierarchical routing, the WSN is divided into chains; and a leader is chosen for every chain. Every node sends the data to the next node until the leader is reached. The main drawbacks are the delays suffered by the farthest nodes in long chains, the overload of the nodes close to the leader and the connectivity loss in a sub chain when a node fails. The most relevant chain based algorithm is PEGASIS (Power Efficient Gathering in Sensor Information Systems) [1 9], where the leaders are rotated for energy reasons, and they send the aggregated data to the sink. In tree based routing algorithms, a sink tree is created and there is a single path between each node and the sink. Unlike the chain based case, there are no leaders, and a parent node can receive data from several children (or leaves), unlike the previous case, a node (parent) can have several children that send data to it, enabling the possibility of aggregation. The main drawbacks are similar to the chain based case, i.e., the delays suffered by the farthest nodes in long trees, the overload of the nodes close to the sink and the connectivity loss in branches connected to a parent that fails. The most relevant tree based algorithm is PEDAP (Power Efficient Data gathering and Aggregation Protocol) that uses the optimum sink tree based on data volume and transmission distance. In grid based algorithms, the whole network
is split into many grids (similar to clusters), based on the geographical location of the nodes. The leader selected for every grid is the responsible for routing the data through other leaders until reaching the sink, i.e., using multihop transmission. Each node only needs to know the location information about the leader of the grid. The most important proposal of this type is Two tier data dissemination (TTDD) ,where the mobile sink use flooding to send a data request to source nodes. In area based mechanisms, the entire network is divided into multiple variable sized areas. The BS also transmits a data request to the closest nodes that they forward via flooding until the data source is reached, which will send the data to the sink. A typical area based algorithm is Line based data dissemination (LBDD) where a line of leaders is selected to split the whole network in two areas. The nodes send data to the closest leader on the line, and the leaders on the line store data from nodes and serve requests from sink if possible, and if not, send the request up and down the line. A little improvement was proposed in Ring Routing [13], using a ring instead of a line algorithms. Additionally ,recently, the Optimized QoS-based Clustering with Multipath Routing Protocol (OQoS-CMRP) has been proposed [21] by applying the Modified Particle introduces an algorithm that uses fuzzy logic for cluster construction and CH selection, and ACO for inter-cluster routing to mitigate the hot spot problem and extend network lifetime. In an interesting PSO-based unequal and fault tolerant clustering protocol (PSO-UFC) is presented. It also use a cuckoo optimization algorithm (COA) for clustering and selection of optimal CHs, considering four criteria such as the remaining energy of nodes, distance to the base station, within-cluster distances, and between cluster distances. In [16] a multihop LEACH protocol is optimized by means of an ACO algorithm, using a CH close to the BS. Other recent works that propose LEACH optimizations are the in using a Fuzzy C-means clustering (FCM) Algorithm, the work in [168] that uses a PSO algorithm or the optimization made in [16] by means of a Genetic Algorithm. Another interesting work is that of Jain and Goel [17] where fuzzy sets and fuzzy decision rules have been used for intelligent selection of CHs and to setup multihop routes to BS. Although LEACH is the preferred protocol for using as basis for optimization, other cluster-based protocols are also used. Therefore, several improvements of PEGASIS has been recently proposed. In [7] an Enhanced PEGASIS (EPEGASIS) protocol is proposed to mitigate the problem of hot spots from four directions. The work in [172] combines PEGASIS with Hamilton Loop algorithm, through a mixture of single-hop and multihop mechanisms, inserting a mobile agent node that is responsible for receiving and merging packets from the CHs. The authors in [13] also combines PEGASIS with a genetic algorithm to build the chain instead of the greedy algorithm.

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The problem of CH selection in APTEEN using artificial intelligence has also attracted the interest of researchers in recent years: using PSO [14], a combination of genetic algorithms and fruit fly optimization algorithm or ACO .

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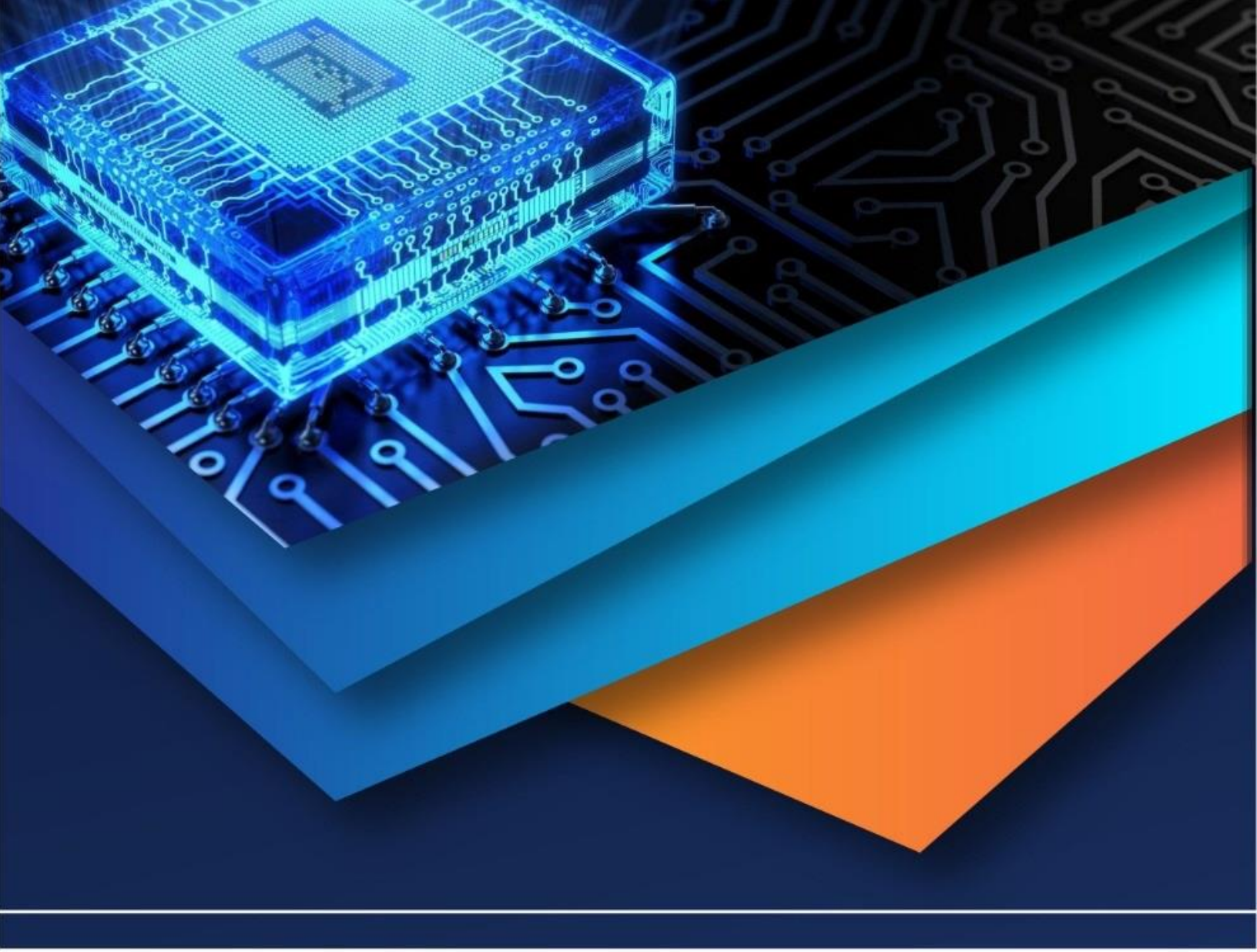

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