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Study of Leach Protocol- A Review

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*Abstract-*Wireless sensor networks have recently come into prominence because they hold the potential to revolutionize many segments. The Wireless Sensor Network (WSN) is made up of a collection of sensor nodes, which were small energy constrained devices. Routing technique is one of the research area in wireless sensor network. So by designing an efficient routing protocol for reducing energy consumption is the important factor. In this paper, a brief introduction to routing challenges in WSN have been mentioned. This paper also provides the basic classification of routing protocols in WSNs along with the most energy efficient protocol named LEACH along with its advantages and disadvantages. This paper also focus on some of the improved version of LEACH protocol.

*Keywords—*WSN, LEACH, lifetime

I. INTRODUCTION

Wireless sensor network is a network consisting of several number of heterogeneous nodes called as sensors nodes which are spatially distributed all over the location. These networks are used to monitor physical or environmental conditions such as temp, pressure, sound, vibration at these locations. Wireless communication enables the co-operation of nodes to fulfill bigger tasks that single nodes cannot. Nodes in WSN are densely deployed and are greater in numbers as compared to mobile ad hoc networks. These nodes communicate with each other and pass data along from one to each other from source to base station. [1]

Recent advancement in micro-electro-mechanical system (MEMS) technology, digital electronics and wireless communication had enabled the development of low-power, low-cost, multi-functional sensor nodes that are in small in size, and communicate untethered in short distance. A sensor network is subject to a unique set of resource constraints such as finite on-board battery power and limited network communication bandwidth. In the typical sensor network, each sensor nodes operates untethered and has a microprocessor and a small amount of memory for signal processing

and task scheduling. Each sensor node communicates wirelessly with a few other local nodes within its radio communication range. [2]

WSN have enormous potential because they expand human ability to monitor and interact remotely with the physical world. Smart sensors are able to collect huge amount of hitherto unknown data, which have the way for a new class of computing applications. Sensors can be deployed and accessed remotely where it is not viable to lay data and power lines.
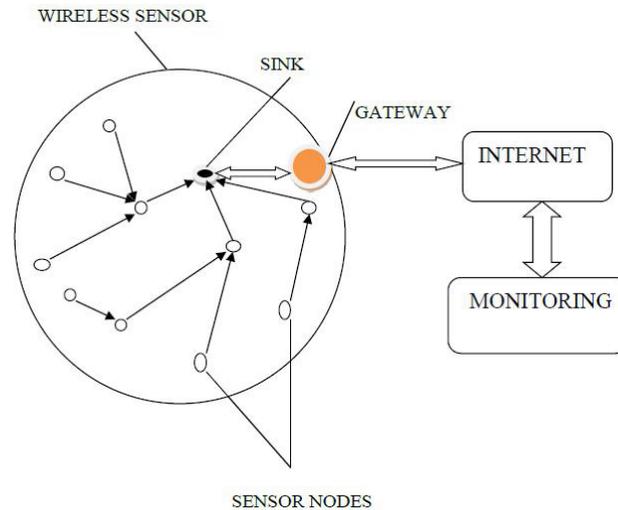

Fig.1.1: Wireless Sensor Network [9]

WSN technology has been proven to have a Strong impact on our daily life from many applications. WSN enable the reliable monitoring of a variety of environments for Application that include Structural Health Monitoring, Industrial Automation, Civil Structure Monitoring, Precision agriculture, Glacial Environment Monitoring, Planet exploration, Food Industry, Aircraft, Habitat Monitoring of animals, Fire Rescue Applications, Bathymetry, Ocean Water Monitoring, Environmental monitoring, Home security, Logistics control, Machine failure diagnosis, Chemical, Biological detection, Medical monitoring, Battle field surveillance, Machine failure diagnosis, Biological detection, Inventory tracking, Asset management, Traffic surveillance.

II. LEACH PROTOCOL

LEACH stands for Low-energy adaptive clustering hierarchy. It is a clustering-based protocol that minimizes energy dissipation in sensor networks. The reason we need network protocol such as LEACH is due to the fact that a node in the network is no longer useful when its battery dies. This protocol allow to space out the lifespan of the nodes, allow it to do only the minimum work, when it needs to transmit data. The main purpose of leach is to randomly select sensor nodes as cluster-

heads, so the high-energy dissipation during the communication with the base station is spread to all sensor nodes in the sensor network. [3]

The LEACH Network is composed of nodes, some of which are called cluster-heads. The job of the cluster-head is to collect data from their surrounding nodes and pass it on to the base station. LEACH is dynamic because the job of cluster-head rotates.
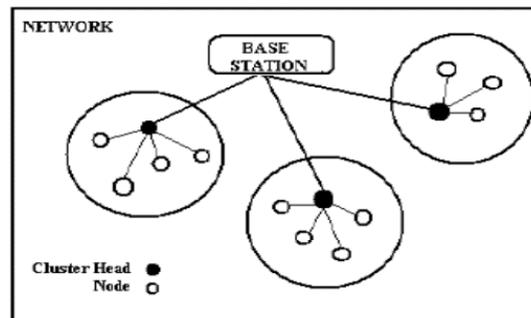

Fig 1.2 LEACH Protocol [3]

The working of LEACH protocol is divided into two phases:

i   Set-up Phase-In LEACH we assume that every node begins with equally distributed energy. So randomly, one node becomes the CH which has not already been CH before and remaining nodes become the member nodes of the cluster. To become a CH, is an energy intensive function. If there is k numbers of nodes present in the network, then for the next round k-1 nodes have the probability to become next CH node.

ii Steady State Phase- In steady state phase data transmission begins. The member nodes of cluster send their sensed data to the CH node in its TDMA slot. After the computation and data aggregation the cluster head send it to the base station.

III. LITERATURE REVIEW

Nejah NASRI et. al [4] had studied about Approach for Clustering in Wireless Sensors Networks Based on LEACH. Wireless sensors networks (WSNs) are traditionally composed of large number of low-cost and tiny homogenous sensors nodes connected through a wireless network that gather data to be treated locally or relayed to the sink node through multi-hop wireless transmission. In this paper he discussed about optimization Low Energy Adaptive Clustering Hierarchy (OLEACH) to improve existing LEACH and LEACH-C by selecting cluster according to the residual energy of nodes dynamically. He shows that proposed algorithm achieve longer stability by comparison to original LEACH and LEACH-C. Detailed simulations of wireless sensors network environment

demonstrate that our approach is a good candidate to increase the period of stability of network, and has the ability of extending the life span of the whole network. From their point of view O-LEACH will work in dynamic networks as well as in static networks. In this paper he evaluated O-LEACH only on static networks. This protocol should be tested on dynamic networks as well.

Sapna Choudhary et. al [5] has presented Survey of LEACH Protocol and its Modified Versions in Wireless Sensor Network. Leach protocol which is one of the energy efficient clustering protocol. Leach is an effective in prolonging the network life time by consuming a small percentage of the total dissipated energy in the system. In this paper they surveyed on LEACH protocol and various LEACH-Based hierarchal routing protocols like LEACH-C, M-LEACH, E-LEACH, and V-LEACH. In this paper, a well-known protocol in wireless sensor networks called LEACH is described. LEACH is first low energy protocol introduced in WSN which save energy and increase lifetime of the sensor networks. With the number of advantages of LEACH protocol it also comes with some disadvantages. To overcome those disadvantages and m-LEACH more efficient many descendants of LEACH protocol are introduced and some of them like C -LEACH ,MLEACH, E-LEACH and V-LEACH are described in this paper that how these protocol overcome the disadvantage of the LEACH protocol and make the sensor networks more efficient.

Chunyao FU et al [6] has studied about An Energy Balanced Algorithm of LEACH Protocol in WSN. In response to the uneven energy distribution that is caused by the randomness of cluster heads forming. Electing cluster-heads randomly in LEACH protocol causes that the current energy of some cluster-heads are less or their distances to base station are far, because of the heavy energy burden, the cluster heads will die soon. For this issue, this article proposed a new improved algorithm of LEACH protocol which is aim at balancing energy consumption of the whole network and extending the network lifetime by balancing the energy consumption of these cluster head. This paper proposes a new improved algorithm of LEACH protocol (LEACH-TLCH) which is intended to balance the energy consumption of the entire network and extend the life of the network. The new algorithm is simulated by Matlab simulation platform, the simulation results indicate that both energy efficiency and the lifetime of the network are better than that of LEACH Protocol.

Qian Liao et al [7] presented An Energy Balanced Clustering Algorithm Based on LEACH Protocol. Among the current researches, the clustering routing technology is the most widely influential. Low-Energy Adaptive Clustering Hierarchy (LEACH) is a classical clustering routing in wireless sensor networks. This paper analyses the effectiveness of LEACH protocol in cluster-heads selection, and proposes an improved clustering algorithm. The new algorithm takes node's residual energy and location information in account, optimizing the selection method of the threshold for electing cluster-head, improves optimal. On the basis of traditional LEACH protocol. This paper proposes an energy

balance algorithm which optimizes cluster-head selection. This algorithm considers the residual energy and distance factors, improves cluster-head election and the strategy of non-cluster head node selecting the optimal cluster-head. As it is proved in the simulation result, the improved algorithm can effectively balance the network energy consumption, heighten system data transmission, and prolong the nodes and network life. Cluster-head selection strategy that is normal nodes select the optimal cluster-head based on the cost function. Simulation results shows that the improved protocol is better than LEACH in balancing the node energy consumption, improving the efficiency of data transmission and prolonging the network life.

Meena Malik et al. [8] has studied about Analysis of LEACH Protocol in Wireless Sensor Networks. LEACH is energy-efficient hierarchical based protocol that balances the energy expense, saving the node energy and hence prolongs the lifetime of the network. So this paper gives a detailed review and analysis of LEACH protocol. Comparison of different network parameters is done in the form of tables and graphs. The main concern of this work is to examine the energy efficiency and performance of LEACH protocol using own set of parameters. We compare the lifetime and data delivery characteristics with the help of analytical comparison and also from our simulation results. From this research we find that LEACH provides better results for number of cluster

Heads as 3 and 4. This paper has covered performance of LEACH protocol only, we can also compare this protocol with different routing protocols that may or may not be hierarchical in nature.

Ravneet Kaur et al. [9] has studied about Comparative Analysis of Leach and Its Descendant Protocols in Wireless Sensor Network. Leach Clustering Hierarchy (LEACH) is a well-known routing protocol in WSN. It is a Clustering based protocol which helps in improving the lifetime of wireless sensor network. This paper describes the comparative analysis of LEACH protocol with its various descendant protocols. In this paper, a well-known protocol in wireless sensor networks called LEACH is described. LEACH is first low energy protocol introduced in WSN which save energy and increase lifetime of the sensor networks. With the number of advantages of LEACH protocol it also comes with some disadvantage. To overcome these disadvantages and make LEACH more efficient many descendants of LEACH protocol are introduced and some of them like E-LEACH, TL-LEACH, MULTI-HOP LEACH, LEACH-C, CELL-LEACH and VLEACH are described in this paper that how these protocol overcome the disadvantage of the LEACH protocol and make the sensor networks more efficient.

IV. PROBLEM DEFINITION IN WSN

- Ease of Deployment - Sensor Network may contain hundreds untill thousands node
- System Life Time - Long life time as possible

- Latency - Data distribution is time sensitive

- Quality - Reduce same redundant data between nodes

V. ADVANTAGES AND DISADVANTAGES OF LEACH [12]

> ### ADVANTAGES:

- Theoretical analysis go better with the simulation results.

- Leach Is Fundamental Algorithm Design, in a Hierarchical topology

- Better System Life Time and Energy Utilization.

- The algorithm provides extended network coverage (low latency).

> ### Disadvantages:

- Fault-tolerance issues – when nodes fail or behave unexpectedly

- The paper assumes all the nodes are homogenous in nature means with same energy – this assumption may not be realistic

VI. CONCLUSION

In Wireless Sensor Networks the main purpose of designing energy efficient routing protocol is to efficiently use the energy of the network so that the network lifetime get increased. In this paper one of the most efficient routing algorithms everyone uses is the LEACH routing protocol. In this survey period, studied briefly about LEACH protocols and we able to distinguish various disadvantages of this protocol along with its advantages. The literature review on WSN, LEACH, E-LEACH, has been conducted in this paper. By conducting the detail study it is found that LEACH protocol technique can be used to minimize the energy dissipation in sensor network.

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