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ANALYSIS OF LEACH ROUTING PROTOCOL

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Abstract - *A Wireless sensor network consists of hundreds and thousands of tiny devices that are capable of communicating with each other with limited power. These Wireless sensors are deployed in our own environment to sense various environmental effects. One of the most important issues in Wireless sensor network is the inherent limited battery power of the network sensor nodes. The life time of WSN is very much dependent on the life of each sensor node. Hierarchical protocols are the best known protocols to minimize the energy consumption. LEACH is one of the fundamental protocol in the clustering technique that can be used for minimizing the energy consumed in collecting and disseminating the data. This paper highlights basics knowledge about LEACH.*

Keywords*: -Wireless sensor network, Routing, Clustering, Cluster head, LEACH*

Introduction:

Wireless sensor network is a network which is widely considered as one of the most important technologies of the 21st century [1]. A wireless sensor network consist of large number of sensor nodes. These sensor nodes are low cost units which are multifunctional and have limited power and memory. These sensor nodes are deployed to monitor physical and environmental conditions such as temperature, sound, pressure, motion, humidity, vibrations or pollutants. WSN is very useful for monitoring remote locations where human access is limited or not possible at all.

The sensor node senses the physical quantity being measured and converts it into an electrical signal. Then the signal is fed to A/D converter and is ready to be used by the processor. The processor will now convert the signal into data depending on how it is programmed and then it sends the information to the network by using transreceiver. This can be understood through the block diagram through fig.1.

Each network has at least one base station where these sensor nodes sends their data which they collect by sensing [2]. A sink or base station acts like an interface between users and the network shown in fig.2. The fundamental objectives for WSN are reliability, accuracy, flexibility, cost effectiveness and ease of deployment.

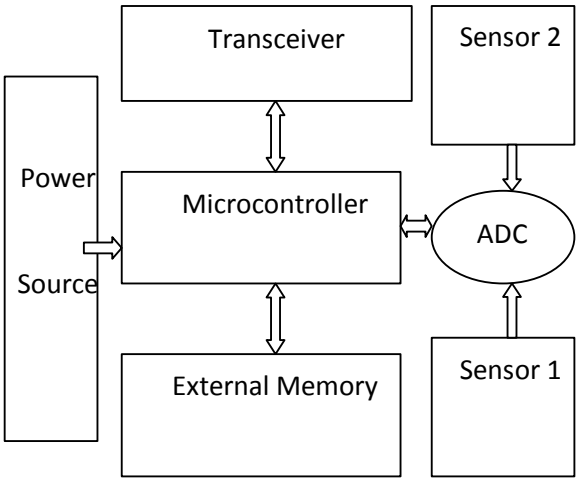

fig1. WSN communication architecture

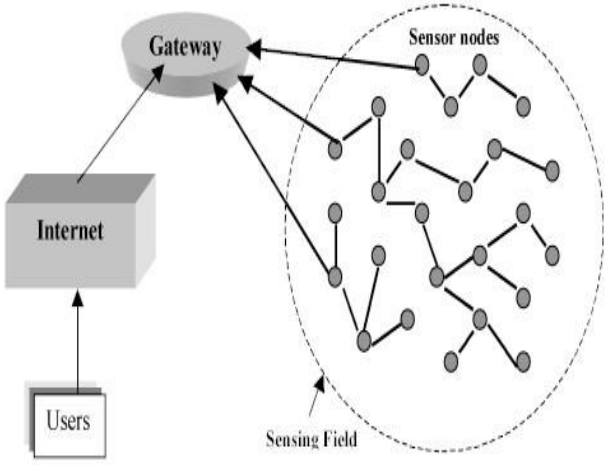

fig 2. Hierarchical wireless sensor network

Routing:
In WSN routing is a very important task that is to be done carefully. Routing is the process of selecting a path for traffic in a network, or between or across multiple networks [3]. The process of moving a packet of data from source to destination. Routing techniques are required for sending the sensed data between the sensor nodes and base station. The main criterion focused in this paper is about the routing protocol that leads to increased network lifetime and decreased energy consumption. The hierarchical based protocol which is a cluster based protocol, is the best protocol to reduce the energy consumption.

Clustering:
Clustering is a task of grouping a set of nodes in such a way that objects in the same group (called clusters) are more similar in some sense or the other to each other than to those in other groups or clusters [4]. In WSN nodes are grouped into clusters and has a cluster head as in fig.3. The nodes in a cluster does not communicate to the base station directly instead they send their data to cluster head and then the cluster head sends the aggregated data to the base station.

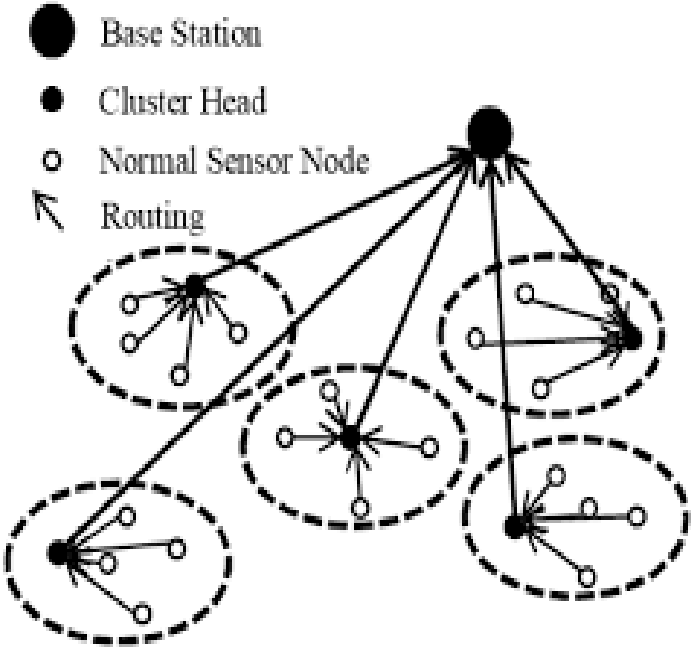

Fig.3. clustering

Low Energy Adaptive Clustering Hierarchy (LEACH) Protocol:
Leach is an energy efficient or energy conserving routing protocol for wireless sensor network which was proposed by Heinzelman, Chandrakasan and Balakrishnan in the year 2000 [5].

Leach is a Time division multiple access based MAC protocol [6][7]. The principal aim of this protocol is to improve the lifespan of wireless sensor network by lowering the energy consumption which is required to create and maintain cluster heads. In LEACH direct communication is used by cluster head. LEACH divides network into several clusters. Since energy dissipation of the sensor depends on the distance, LEACH attempts to transmit data over short distances and reduce total no. transmission and reception operations.

In order to achieve the design goal the basic task performed by LEACH are [8]:
i. Randomized rotation of cluster head
ii. Local aggregation of data to reduce global communication
iii. Localized coordination and control for cluster setup and coordination

The operation of LEACH protocol consists of several rounds with two phases in each [9]. First one is the set up phase and second one is the steady state phase as in fig4.

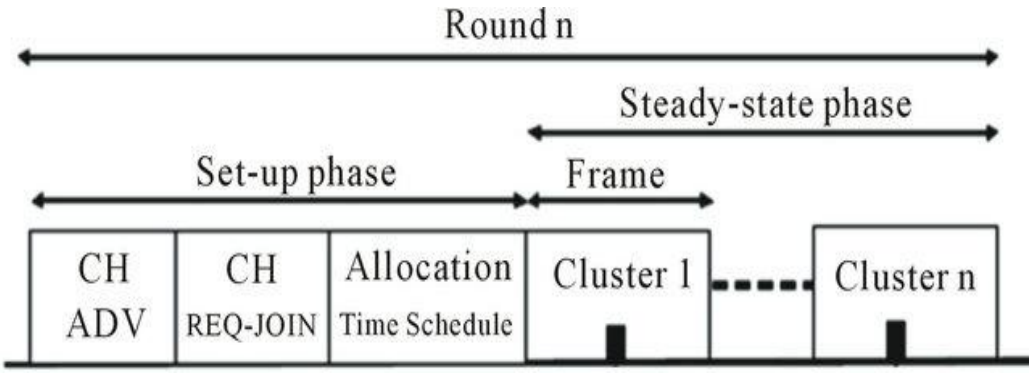

Fig4. TDMA schedule of LEACH

1) SET UP PHASE:
In set up phase the main goal is to make cluster and select the cluster head for each of the cluster by choosing the sensor node with maximum energy. Set up phase comprises of three steps:
a) For organizing the network into clusters
b) Advertisement of the cluster heads
c) Transmission scheduled creation

In this phase it decided whether to become a cluster head or not for the present round. Every sensor node select a random no. between 0 and 1. If this random no. is less than the threshold T(n) that node is chosen as cluster head for the current round.

The equation of T(n) is given as:

$$T(n) = \frac{P}{1 - P \times (r \bmod \frac{1}{P})} \forall n \in G$$

$$T(n) = 0 \forall n \notin G$$

P= percentage of choosing CH
r= current round
G= group of sensor nodes that have not been CH the 1/P round
2) STEADY STATE PHASE:
Steady state phase is comparatively longer in duration than the set-up phase. The steady state phase mainly deals with the aggregation of data at the cluster head and then the transmission of the aggregated data to the base station. In this phase nodes send their data to the cluster head using TDMA schedule. TDMA schedule allots time slot to every node. Then cluster head aggregates the data and send it to the sink.

Advantages of LEACH:
a) The cluster head aggregate the whole data which leads to reduce the traffic in the entire network.
b) Single hop routing from node to CH results in saving energy.
c) The information about the location of the nodes to create the cluster is not required.

Disadvantage of LEACH:
a) Leach does not give any idea about the no. of cluster heads in the network [7].
b) Most basic disadvantage is if due to any reason cluster head dies, the cluster will become useless because the data gathered by the cluster heads will never reach its destination.
c) Clusters are divides randomly which results in uneven distribution of cluster head, some CH will be in center and some will be on the edges of cluster this will result in the increase of energy consumption.
d) Similarly some clusters may have more nodes and some may have less this will also result in uneven energy consumption.

Conclusion:

One of the main challenge in the design of routing protocol for WSN is energy efficiency due to the scarce energy resources of sensors. The ultimate objective behind the routing protocol design is to extend the network lifetime of a wireless sensor network. This paper briefs about LEACH protocol. By analyzing the advantages and disadvantages of conventional LEACH protocol various other descendant LEACH protocol have been developed. LEACH is an energy efficient routing protocol but still there is need for finding much more efficient, scalable, fault tolerant and load balancing clustering scheme for better performance.

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