Framework of Energy Efficient LEACH Protocol

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Abstract: Wireless Sensor Networks (WSNs) are restricted in terms of energy resources and thus need efficient energy management throughout the collection, dispensation, aggregation, communication and ultimate exploitation of sensor's data in numerous customized applications that are linked to healthcare, cluster and monitoring of home , security and observation etc. Energy efficiency is the important concern in wireless sensor networks. Thus, to maximize network lifespan and accomplish maximum dependability and scalability, routing methods have been developed. LEACH is the conservative hierarchical clustering protocol that is broadly utilized in WSNs. This paper discuss about LEACH and its importance in wireless sensor networks and also throw light on its variants proposed by different researchers. We have discussed their features too.

Keywords: LEACH, Energy Efficiency, Cluster.

I. INTRODUCTION

Numbers of nodes in wireless sensor nodes are known as sensors which are set up and located in a specified area. A node includes mainly some parts that are transceiver, processor, sensor, unit of energy. These sensor nodes are organized within themselves, synchronized and work together to collects numerous types of information from the environment and deliver necessary data to the base station (BS) for additional processing which distributes this info to the sink node. WSNs have a variety of limitations like incomplete power, computation and communiqué. The power saving battery of the nodes chooses the lifetime of the network. All sensor nodes practices and broadcast data to the BS (sink) (BS). However the nodes have incomplete battery and little life span Therefore by applying this energy in a resourceful manner and raising the lifespan of nodes is the major concern. Most recent work in WSNs is related to energy efficiency which is the major concern that affects the lifetime of the network. Diverse energy aware protocols are developed to increase network lifetime.[1]

Sensor nodes may vary depends on the kinds of applications they are used in; e.g. some nodes involve more powerful to gather, process, and way sensory data from numerous sensing nodes; other may be ready with special hardware such as a GPS receiver to perform as flare for other nodes to deduce their location; likewise, some nodes may behave as gateways for a long-range data communication networks.[2]

II. LEACH PROTOCOL

LEACH Protocol is a usual presentation of hierarchical routing protocols. It is known as self adaptive and self structured. This protocol utilizes round as unit, every round is completed with cluster set-up stage and steady-state stage, for the reason of reducing needless energy costs, the steady state stage should be much greater than the set-up stage.[3]

LEACH Protocol is considered to be the first protocol of hierarchical routings that planned data fusion; it is of highlight significance in clustering routing protocols. Numerous hierarchical routing protocols are enhanced ones based on LEACH protocol [4]. As, wireless sensor networks steadily go into our lives, it is of great importance to research on LEACH protocol. At the stage of forming cluster, a node arbitrarily chooses a number between 0 to 1, on comparing this number to the threshold

values, if the number is less than threshold, then it develop into cluster head in this step, else it become an ordinary node. When clusters are created, the nodes start to broadcast the inspection data. Cluster heads accept data sent from the other nodes, the acknowledged data was sent to the gateway after fused. This is a enclose data transmission. In order to lessen needless energy cost, steady stage is consisted of multiple frames and the steady stage is much greater than the set-up stage.[4]
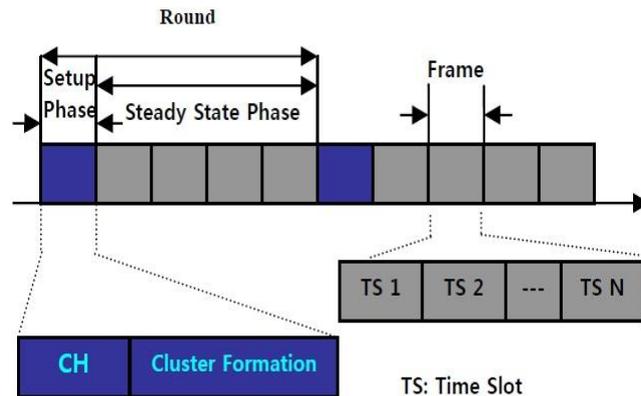

Figure 1: Analysis of LEACH performance

III. VARIOUS VARIANTS OF LEACH

Numbers of variants of Leach protocol have been proposed after noticing the problem of LEACH protocol. Few of these are LEACH-C , LEACH-E , TLLEACH , LEACH-H , M-LEACH , V-LEACH , LEACH-B , LEACH-FZ and U-LEACH .Looking into the arrangement of the cluster heads , that are not evenly distributed in LEACH protocol. They may be positioned at any place in the cluster.

1. LEACH-C – LEACH-C version of LEACH protocol is an upgraded protocol over the LEACH protocol. This protocol utilizes the central clustering algorithm, and the phase named as steady-state that is used by LEACH. In this protocol every node transmits their current location data and remaining energy level to the sink.[5]

2. LEACH-E - LEACH-E protocol named as Energy LEACH is the version of LEACH protocol where the selection of cluster head is based on the remaining energy level of the nodes. The remaining energy level chooses that whether the node will develop into a cluster head or not after the first step. Here all nodes have equal chances to become the cluster head in the first round. The outstanding energy level in the second step is dissimilar for each node since the first step communication. In this protocol the nodes that have a additional energy level will develop into the cluster head relatively than the nodes having low energy level. Thus, this protocol gets better the cluster head selection method. The difficulty with LEACH protocol may happen when the cluster head is at distant from the base station. The cluster head that is distant from base station need more energy to transfer the data to the base station and thus it will die soon.[5]

3. TL-LEACH – TL-LEACH stands for two-level LEACH. This protocol was designed to solve the problem of cluster that is far away from base station and want to send data. Here, the cluster head is dependable for gathering and fusion of data similar to LEACH protocol from individual cluster members, but the heads of cluster will not directly onward the data to the base station. It makes the use of one of the cluster head that is placed between cluster head and base station as a transmit station.[5]
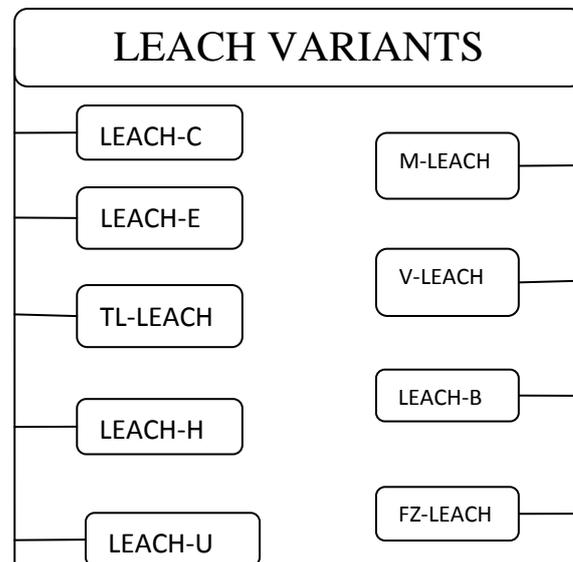
Figure 2 Variants of LEACH Protocol

4. LEACH-H - LEACH-H stands for Hybrid Cluster Head Selection Leach and was given to defeat the defect of short endurance time and low degree of balancing the load in case of LEACH. It utilizes the benefits of LEACH and LEACH-C. Cluster head is chosen in the first round by base station in LEACH-H, which efficiently solves the problem that the number of cluster head is undecided in LEACH. In the other steps, the new cluster head utilized in the next round is chosen in their own cluster by the present cluster head in LEACH-H, which solves the matter of the reliance on the base station in LEACH-C.[6] If the cluster head is distant from base station then it may need large amount of energy to send the data to base station.

5. M-LEACH - M-LEACH stands for Multihop-LEACH protocol. This can be used for the cluster head that is far from base station and require large energy. It works by altering the transmission mode among cluster heads and base station from solitary hop to multi hop. This protocol selects the best potential path among the cluster head and base station by applying the other cluster heads as transmit stations to send data to base station. [6] The cluster head, in LEACH protocol is liable for receiving data from cluster members, synthesis of received data and then transmit it to the base station. If base station is distant from cluster head then cluster head will expire soon on comparing to other nodes since the energy will disperse in getting and forwarding of the data. If the cluster head expires then the data composed by the cluster head will never achieve by the base station and so the cluster will become useless.

6. V-LEACH - V-LEACH stands for vice cluster LEACH and it is responsible to resolves the setback of M-LEACH by launching the vice-cluster head. In V-LEACH protocol a cluster consists of a cluster head, vice-cluster head and nodes of cluster .Here, in this protocol if the cluster head expires then vice-cluster head will begin working as cluster head and the head data will be achieved to the base station. There is no requirement for choosing the new cluster head, so it will accumulate the energy and improve the network life time.[6]

7. LEACH-B resolves the setbacks, amount of cluster heads and the unawareness of the node's remaining energy, found in LEACH. This protocol inserts a second election for cluster heads to alter the number cluster-head in the set-up phase allowing for the node's residual energy per round. For saving the energy utilization and to extend the life span of the network, the protocol guarantees that the divider of cluster is balance and consistent.[8]

8. FZ-LEACH removes the problem the lessening in life span of WSN occurs because of large and very tiny clusters in the network by appearing Far-Zone. Far-Zone is a known as a group of sensor nodes that are placed at sites where their energies are of a smaller amount than a threshold. LEACH uses randomized rotation.[8]

IV. RELATED WORK

Much work has been contributed towards the LEACH protocol to improve the energy efficiency in wireless sensor networks. Liu et.al, in the paper, [7] "LEACH-GA: Genetic Algorithm-Based Energy-Efficient Adaptive Clustering Protocol for Wireless Sensor Networks" proposed a algorithm based on genetic adaptive clustering protocol having an optimal probability calculation for achieving better performance in wireless sensor networks lifetime. They analyzed that the LEACH protocol needs the user to identify this probability for using with the threshold function in formatting whether a node becomes a Cluster Head or not also, the network performance is tremendously receptive to this probability, and it is very tough to obtain an most favorable setting from available previous knowledge. Thus in their method they have utilizes a preparation phase former to the set-up phase of the first step to collect information about node position, IDs, and place and sends it to the Base Station, which concludes the optimal probability to use in the Cluster Head selection method.

Ralhan.R et.al, [8] " Review On Various LEACH Variants" discussed that because of insufficient battery of sensor nodes energy efficiency is the strongest point to consider in wireless sensor networks. As no substitute and charging are presented for sensor nodes, so use them in optimized manner has open explore for sensor researchers. Therefore they have discussed about the most efficient variants of LEACH protocol and conclude that from all of them Ant Colony Optimization that is based on energy efficient protocols have capable results.

Afsar et.al,[9] "A Performance and Comparative Analysis of LEACH- its Variants and Different Matrices" discussed that wireless sensor networks are restrained forced related to energy resources and thus they need efficient energy management during compilation , processing , aggregation, communication and ultimate operation of sensor's data in numerous modified applications associated to healthcare, cluster and home monitoring, security and inspection etc. They have discussed in their paper about hierarchal efficient clustering protocol and compared it on various factors for e.g lifespan of network, initial nodes energy effect and node density of network lifespan.

Poonam Shrivastava et al, [10] " Analysis of LEACH and Its Variants for Routing in Wireless Sensor Networks", discussed about LEACH protocol and how it is implemented in wireless sensor networks. They noticed that there are many devices that require sensory data from the real world which is supplied by WSN and energy efficiency is the main concern for sensor networks. Thus LEACH(Low –Energy adaptive clustering hierarchy) which is known as routing protocol for wireless sensor networks provide good results in terms of efficient energy. In their work they have analyzed LEACH performance on various factors such as energy, throughput and lifetime with the help of network simulator-2

Bakaraniya et.al, [11] " K-LEACH: An improved LEACH Protocol for Lifetime Improvement in WSN", discussed that wireless sensor network is a large group of sensor nodes and thus they are more sensitive to energy consumption as compared to wireless networks. Therefore in their study they have proposed a new algorithm for LEACH protocol known as Kmedoids-LEACH (K-LEACH) and its main aim to extend the lifespan of wireless sensor networks by balancing the energy utilization of the nodes, they have compared the results of LEACH and K-LEACH using simulation and conclude that K-LEACH gives better performance than LEACH.

V. FRAME WORK FOR LEACH PROTOCOL
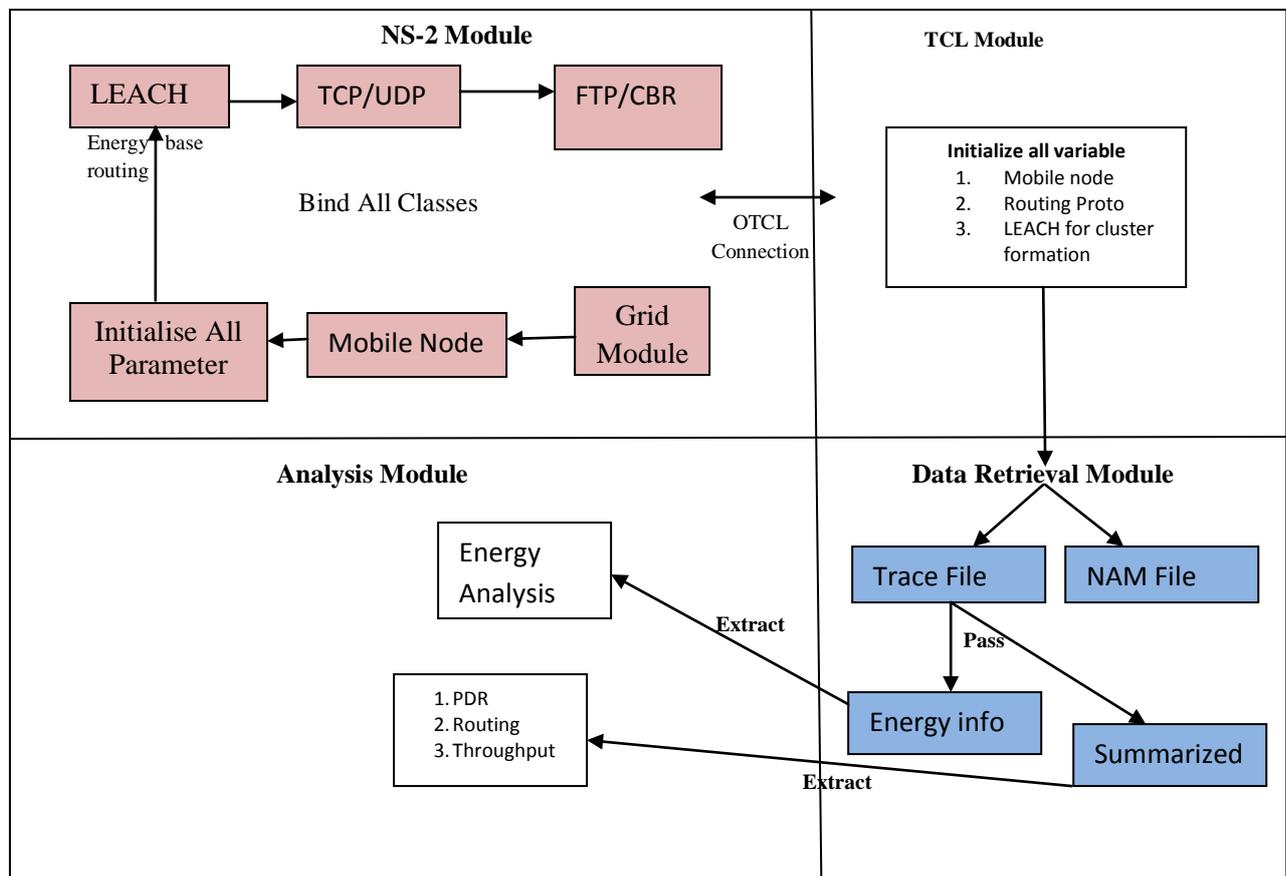
VI. CONCLUSION

The main restraining factor for the lifetime of the sensor network is the supply of energy. Each sensor node must be planned in such a manner that it uses its battery supply in order to exploit total network lifetime. Clustering in the network's topology lessens number of transmissions in the network. It also supplies energy efficiency because cluster heads combines the data from its cluster members, thus decreases replication of transmission and improves the network lifetime. Here in this paper, we have offered selected variants of LEACH protocol for WSNs which explains various alterations carried over the primitive LEACH and decorated their features.

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