# An Approach for Cluster Head Selection using Hybrid Election & Recovery Method in WSN: A Survey

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*Abstract*— WSNs have used research area due to their several application domains. The presentation of WSNs depends on the topology of sensors and their ability to adapt to changes in the network. Sensor nodes are often resource constrained by their limited power, communication distance capacity is low, and restricted sense capability. Therefore, they need to co-operate with each other to achieve a specific task. [1] [3] Thus, clustering enables sensor nodes to communicate through the cluster head node in constant communication process. In this paper, we introduce a dynamic cluster head election technique. Every node in the cluster calculates its residual energy value to determine its candidacy to become the Cluster Head Node (CHN). [1] With this mechanism, each sensor node estimates its residual energy level to other nodes in the same cluster. Lean on the unused energy level the sensor node acts as the second cluster head. Interpretation of the dynamic CHN election mechanism is shown using network simulator-2 (ns2). The simulation results show that the recommended methods drag out the network lifetime and adjust the energy utilization model among the nodes of the cluster. [2]

***Key words:*** Cluster, Traffic, Cluster Head, Energy factor, Resources, Lifetime

## I. INTRODUCTION

Wireless sensor network's involvement limited communication bandwidth and energy constraints. WSN is based on data-centric wireless network that does not need to focus on the sender and receiver. Unlike, traditional wired network, mobile wireless network and ad hoc network care extra about the sender and receiver.[2] Therefore, a general IP based mechanism and multi-hop routing scheme for mobile ad hoc network is not suitable for WSNs. The hierarchical routing protocol is one kind of typical network protocol for WSNs to handle the faults of the flat traditional cluster based routing scheme. Thus, it spreads the network lifetime as well as guarantees better connectivity of the whole network. [1] Energy feasting is one of the serious problems in WSNs that creates challenges for academic and industrial sectors. Therefore, energy, handling is one of the key skills to spread the network lifetime.[2] There is a quadratic increase in energy ingesting as the distance among sensors increases. Thus, the distance should be kept under thought while designing the WSNs to minimize energy consumption and prolong network lifetime.[3] Scalability is the second major threat in WSNs where thousands of sensor nodes are deployed in confident applications. In WSN's these matters are addressed at the cluster level by using different cluster-based architectures.

## II. CLUSTERING APPROACH IN WIRELESS SENSOR NETWORK

Hierarchical clustering is the efficient way [5] to use the energy in the best manner. The group of clusters performs the same task is known as the clusters. Clusters head, regular nodes and base station are the main components of the hierarchal cluster. When the cluster head is selected it gathers all the data from all its member nodes and fuses it in order to abolish the reiteration. Thus, it restrains the amount of data transmitted to the Base Station, hence remaining energy level is improved and network lifetime is also prolonged. There are various key aspects [6] which must be thoroughly considered, while designing the clusters in WSN:

### *A. Clustering Detail*

1) Multiple Clusters: Multiple clusters may switch as per the CH selection algorithm.
2) Intra-Cluster Communication: Conversation between the regular node and CH may be one-hop communication or multi-hop communication.
3) Nodes and CH Mobility: Construction of the cluster is dynamically commutated in the case of sensor nodes are in mobility.
4) Types of Nodes and its Role: The nature of the node may be homogeneous or heterogeneous. In homogeneous, all sensor nodes have same abilities such as same energy level, configurations. In heterogeneous, nodes are changes in configurations.
5) Cluster Head Selection: Based on the benchmarks such as connectivity, outlay of communication, resting energy, mobility CH is elected from the distributed nodes. CH selection may be in the deterministic or opaque way.
6) Multiple Levels: Multi level clustering approach is used to achieve better energy distribution, in very large networks.
7) Overlaying: Overlaying of different clusters in not supported by most of the protocols.

### *B. Matter of Dispute in Clustering*

To create a managerial structure between sensor nodes in WSN, it has the capabilities to distribute them in an ad hoc manner, because it is not possible to maintain these nodes into groups, pre distribution. To achieve the managerial structure, there has been a large amount of researches are in the progress. The clustering inconsistency having an important part not just in protecting the network, but can seriously affect the network achievements. There are a number of impediments that clustering scheme must consider.

1) Confined Energy: Wireless Sensor Nodes having limited energy storage and the able use of this energy will be required in determining the range of suitable application for this network. The confined energy in the sensor nodes must be considered as proper clustering that can overcome the complete energy usage in a network.
2) Network lifespan: The energy limitations of the nodes resulting in confined network lifespan for the nodes in

 

the network. Proper clustering should attempt to reduce the use of energy, and hereby increase network lifespan.

3) Confined Abilities: The limited physical size and limited amount of stored energy in the sensor node confined many abilities of nodes in the term of processing and communications abilities. A good clustering algorithm should make use of shared resources within a managerial structure, while taking into account the limitation on individual node abilities.
4) Application Dependency: Often a given application will densely depend on cluster organization When designing a clustering algorithm, application strength must be considered as a good clustering algorithm should be able to adapt to a variety of application requirements.

## III. CLUSTERING ALGORITHMS

### *A. LEACH Protocol (Low Energy Adaptive Clustering Hierarchy)*

LEACH gathers the data from dispersed sensor nodes and transmits it to the base station. Some of the nodes elect themselves as a cluster head. The elected cluster heads gather sensor data from other nodes in the local area and transfer the gathered data to the base station. The procedure of transferring data to the base station is very energy exhausting. In LEACH [7] cluster head selection based on the selected percentage of CHs for the network. Every node selects an odd number between the interval 0 & 1. If the produced odd number is less than the verge then the node becomes a CH for the current round. A round is a method of selecting cluster head, Cluster establishment, and data communication at the same time. Each round consists of two stages: - (a) Set-up stage (b) Steady state

1) Set-up stage: In the set-up stage cluster head makes an announcement of its election by sending message to all other nodes in order to form a cluster.
2) Steady state: - cluster head makes a TDMA schedule for their member to transfer their data and endorse when it to transmit, nodes send data in the given time. Transmission of the regular nodes is switched off until their schedule is arrived, to save the energy. Finally CH accumulates the gathered data and sends to base station.

*1) Obstacle in LEACH:*

1) Election of cluster head is odd and also not cares about the energy utilization of nodes. Because of this cluster head may succumb, if the CH succumbs the cluster became invaluable,
2) Mostly it breakdowns to cover big areas and not consistent with the handling of CHs,
3) It is incapable to address the schedulability and predictability measures.

### *B. ACW (Adaptive Contention Window)*

To elect the cluster head, an Adaptive Contention Window (ACW) is offered in this section. The fundamental goal behind the offered ACW-based head selection structure is that all sensor nodes pick an evacuation value from the contention window based on the homogeneous distribution at random and then the sensor node with minimum evacuation can be cluster head in its communication rang. ACW can randomly elect a cluster head.

*1) System miniature:*

in our system miniature we assume that all the sensor nodes are integrated by a certain integration structure [3]. In the opening of every round the all sensor nodes make use of an existing contention based medium access control (MAC) protocol to clash the channel. If the channel contention is a lucrative sensor node become a cluster head. Next the cluster head frequently transmit a signal to launch other sensor nodes to be its member in order to form a cluster. If the environment between the request node and response node are well-being with certain parameters such as distance or receiving power, the respond node confirms the request node and become a representative of this request node. The ACW algorithm can attain four extensive goals in cluster head selection for WSNs.

1) The great expectation of lucrative cluster head selection
2) A convenient number of cluster heads
3) ACW is capable to consistently circulation of cluster heads,
4) For every sensor time is balanced to be a cluster head, all together.

### *C. CIPRA (Clustering and In-Network Processing Routing Algorithm)*

CIPRA is an impressive data selection technique which employs a hierarchical clustering algorithm and In-network processing. CIPRA improve the lifetime of the network by dividing energy utilization. CIPRA distributed the energy load of the cluster head to the representative sensors so that energy of each sensor fairly temper overall network. In CIPRA when sensor feels the data every node sends the data to its adjacent node rather than cluster head. Adjacent nodes combined data to reduce the amount of data and transfer the combined data to their nearby nodes, which might be their cluster head. By adopting the local report of each sensor CIPRA is capable to construct a data routing tree itself. The sensor should forcefully accommodate radio transmission energy to modify the revaluation in the network topology due to diaphaneity of nodes. The adjacent nodes reduce the communication rang by using the local communication between the nodes. In network growth at each member node spread the energy load of cluster head for the member nodes. The main aim of CIPRA to spread the energy load to every node to neglect the huge energy utilization of the cluster head.

## IV. CLUSTERING ALGORITHMS PLANTED ON ENERGY SCRUTINY

### *A. Energy Residue Aware (ERA) Algorithm*

The cluster head selection in this algorithm is same as in the LEACH, But it different in the formation of cluster that is relation between the cluster head and other nodes. When CH is selected as in the LEACH CH estimated their residual energy [10] and sends this information to all other nodes. The residual energy is calculated by subtracting the remaining energy of CH in the current round from energy requirement for transferring data to base station. Similarly, all other regular nodes calculate their residual energy by subtracting their remaining energy in the current round. After this process they collaborate with one CH according to the sum of the maximum energy residual path. Thus, it increases the network lifetime by balancing the energy

 

consumption of the network. In LEACH, shortest distance is selected by the regular nodes to choose the cluster head. That's why there will be a chance that CH dies earlier. As compared to LEACH, ERA extends the network lifetime by equalizing the energy consumption of nodes. ERA guarantees for optimal CH selection by extending the network lifetime, but it not focus on network monotony.

### *B. LEACH-C Algorithm [LEACH-Centralized]*

In LEACH-C, each node sends its coordinate values and energy information to the BS. The BS uses this information to calculate the average energy of the network. A set of nodes having higher energy than the average energy of the network, is eligible to become CH for the current round. LEACH-C finds the desired number of CHs from the set of eligible nodes using a simulated annealing algorithm. In the proposed approach, LEACH-CM, the CH selection and cluster formation methods are same as LEACH-C with two modifications, discussed later in this section. The BS collects information about the coordinates and energy information from all nodes, and calculates the average energy of the network. The set of nodes having energy higher than the average network energy is eligible to become CHs for the current round. The desired number of CHs is identified by BS using a simulated annealing algorithm.

### *C. Efficient Cluster Head Selection Scheme for Data Aggregation [EECHSSDA]*

EECHSSDA [12] reduce the problem of LEACH-C. in this cluster head election is same as the LEACH-C. When the energy of the cluster head decreases it elects a Associative Cluster Head (ACH). If the energy of the cluster head is going to drain ACH play a role of CH. For the selection of ACH the node having the higher energy level after the energy of cluster head is less than average energy act as an ACH. Due to the presence of ACH, there is no need to elect the cluster head periodically. Hence it reduces the load overhead, use of energy and there is no need to elect a cluster head periodically. EECHSSDA promises to obtain best cluster head energy efficiency, but it is also not focus on predictability.

### *D. Hybrid Energy- Efficient Distributed Clustering [HEED]*

In HEED cluster head selection depends on residual energy and intra cluster communication cost. HEED [13] is a hierarchal, distributed clustering scheme. There is a single hop communication within each cluster and multi hop communication between CHs and base station. The initial set of cluster head is maintained by using residual energy. Communication between the cluster is used to decide to join a cluster or not. This is based on the node's nearness or node's degree to adjacent nodes. Every sensor node approximate CHpb values for becoming a cluster head as follows:

$$CHpb=Cpb*Eres/Emax$$

This value of probability should not be beyond the threshold value Pmin, Pmin is inversely proportional to Emax. This algorithm is based on the fix number of repetitions. Each node uses these repetitions until it finds a cluster head. CH will be the node with least communication cost. At the end of repetition each node doubles the CHpb value. If this CHpb value reaches to 1 repetition will end. There are two types of cluster head status that a sensor node broadcast to its adjacent.

1) CHpb less than 1 that is node become an experimental CHpb.
2) If CHpb reaches to 1 node become CH for lifelong.

In the last final Cluster head consider a CH and experimental CH becomes a regular node. If two nodes are in the same transmission range of each other then probability of electing cluster head will be small. In HEED simultaneity is required and use of energy is significant if cluster head are at a distance. It also needs feedback of complete network to determine the intra cluster communication cost. Communication cost is very difficult to calculate practically. So it is also very tough to obtain network lifetime bond to ensure predictability.

## V. CONCLUSION

Hybrid election and recovery approach method over WSNs to prolong the network lifetime.[2] We have displayed dynamic election process of cluster head node. The cluster head node is elected on the source of residual energy of sensor nodes. The residual energy is calculated after accomplishment the event monitoring process using the mathematical model. In our scheme, the nodes can switch to their special of cluster even with increased power loads. To establish the strength of CH,. Two types of scenarios are used by the algorithm which is characterized by the amount of activity supposed in the environments. On the basis of simulation results and the mathematical model, we believe that the proposed scheme significantly extends the network lifetime as compared with other schemes.[3]

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