# Performance Calculation of Energy Efficient Cluster Based Routing Protocol for WSN

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***Abstract*- Wireless Sensor Networks (WSNs) are used for checking and information gathering from the physical world in various applications, for instance, condition watching, developing the board, following animals or items, social protection, transportation and general home frameworks The aim of this research paper is the implementation of simulation models and the simulation of energy-efficient network initialization algorithms. Low Energy Adaptive Clustering Hierarchy Protocol for WSNs (LEACH), Power Efficient and Adaptive Clustering Hierarchy Protocol for WSNs (PEACH), Hybrid, Energy-Efficient, Distributed Clustering Approach for WSNs (HEED) and Energy Efficient Clustering Algorithm for Maximizing Lifetime of WSNs (EECML) has been analyzed for calculating their performance based on some network influencing parameter such as Cluster Head, no of packets to BS etc.**

***Index terms*- LEACH, PEACH, HEED, CML, CH, BS.**

## I.INTRODUCTION

Wireless Sensor Networks (WSNs) [1] are used for checking and information gathering from the physical world in various applications, for instance, condition watching, developing the board, following animals or items, social protection, transportation and general home frameworks. Nowadays, WSNs are pulling in unfathomable thought in research (for a progressing study, see, for example, [2]). A WSN involves an ordinarily enormous number of sensor center points, in like manner called bits, passed on in the application circumstance. Bits are equipped with the specific sensors mentioned by the application, and gather information about nature, which is transmitted towards no less than one sink centers (in like manner called base stations). Sink center points assemble and methodology the got data in order to make it open to the customer. Regardless of the way that in a little WSN one-hop correspondence to the sink can be executed, when all is said in done, a multi-ricochet outline must be considered. For this circumstance, ordinary bits are in charge of executing a coordinating tradition in order to propel the information towards the sink. Since bits should as a rule work unattended for a long time, they have extraordinary imperativeness impediments. This profoundly influences the structure of a WSN and unequivocally on the coordinating tradition. Since correspondence is a costly resource to the extent imperativeness use, a creature control message sending segment (i.e., flooding) is the point at which all is said in done silly. Or maybe, the arrangement of the coordinating tradition [3] is a fundamental edge that should consider tradeoffs between transmission power and sending methods in order to give immovable quality and nature of organization. In addition, since a bit ought crash in view of battery exhaustion or distinctive reasons, a capable controlling tradition to be adequately versatile to react to a mistake by reconfiguring the framework [4].

## II. ROUTING IN WSN

Routing is the way toward choosing best ways in a system. Before, the term directing was additionally used to mean sending system traffic among systems. Anyway this last capacity is vastly improved depicted as essentially sending. Directing is performed for some sorts of systems, including the phone organize (circuit exchanging), electronic information systems, (for example, the Web), and transportation systems [5-8].

Most steering calculations utilize just a single system way at any given moment. Multipath directing procedures empower the utilization of numerous elective ways. In case of overlapping/equal routes,

the following elements are considered in order to decide which routes get installed into the routing table (sorted by priority):

1 Prefix-Length: where longer subnet masks are preferred (independent of whether it is within a routing protocol or over different routing protocol) [9].
2 Metric: where a lower metric/cost is preferred (only valid within one and the same routing protocol) [10].
3 Administrative distance: where a lower distance is preferred (only valid between different routing protocols)

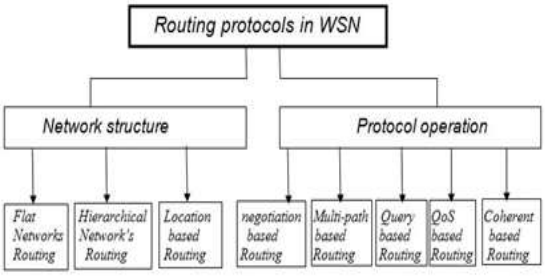


Fig 1: Taxonomy for WSN Routing Protocol

## III. CLUSTER BASED PROTOCOLS

Cluster Based Routing Protocol (CBRP) is a routing protocol designed for use in mobile ad hoc networks. The protocol divides the nodes of the ad hoc network into a number of overlapping or disjoint clusters in a distributed manner. A cluster head is elected for each cluster to maintain cluster membership information. Inter-cluster routes are discovered dynamically using the cluster membership information kept at each cluster head. By clustering nodes into groups, the protocol efficiently minimizes the flooding traffic during route discovery and speeds up this process as well. Furthermore, the protocol takes into consideration of the existence of uni-directional links and uses these links for both intra-cluster and inter-cluster routing [11-14].

### A) LEACH

The author in [6] presented a progressive routing calculation for sensor Systems, called Low Energy Adaptive Clustering Hierarchy (LEACH). LEACH organizes the hubs in the system into little bunches and picks one of them as the group head. Hub_rst faculties its objective and afterward sends the important data to its bunch head. At that point the group head totals and packs the data got from every one of the hubs and sends it to the base station. The hubs picked as the group head channel out more vitality when contrasted with different hubs as it is required to send information to the base station which might be far found. Henceforth Filter utilizes irregular turn of the hubs required to be the bunch heads to equitably convey vitality utilization in the system. After various reenactments by the creator, it was discovered that just 5% of the absolute number of hubs needs to go about as the bunch heads. TDMA/CDMA Macintosh is utilized to diminish between group and intra-bunch impacts. This convention is utilized were a consistent observing by the sensor hubs are required as information accumulation is concentrated (at the base station) and is performed occasionally.

LEACH operations can be divided into two phases:-

1. Setup phase
2. Steady phase

In the setup phase, the clusters are formed and a cluster-head (CH) is chosen for each cluster. While in the steady phase, data is sensed and sent to the central base station.

The steady phase is longer than the setup phase. This is done in order to minimize the overhead cost.

1. Setup phase:-Amid the setup stage, a foreordained portion of hubs, p, pick themselves as group heads. This is finished by a limit esteem, T(n). The limit esteem relies on the ideal rate to turn into a bunch head-p, the current round r, and the arrangement of hubs that have not turned into the group head in the last 1/p rounds, which is indicated by G. The formulae is as follows

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

### B) PEACH

In view of the data caught by every sensor hub, this convention structures versatile bunches [15]. At the point when a hub Ni transmits a parcel to hub Nj then this convention characterizes two arrangements of hubs:

- Node Set (Ni, Nj): It is a lot of all hubs which lies around whose middle is hub Ni and span is the separation between hubs Ni and Nj.
- Cluster Set (Ni, Nj):It is a lot of all hubs which has a place with Node Set (Ni, Nj) be that as it

may, not in Node Set (Base station, Nj) Node Set (Ni, Nj) comprises of hubs which can catch the transmission of bundle from the hub Ni to hub Nj and Cluster Set (Ni, Nj) incorporates CH of each one of those nodes which are caught. Hub Nj turns into the CH of Cluster Set (Ni, Nj) and it waits for T delay to gather various bundles from different hubs in Cluster Set (Ni, Nj). This set stays dynamic for both when T delay, chose CH Nj transmits the gathered information to next jump in the progressive system.

In contrast with different conventions it has no overhead on CH determination and it shapes a versatile staggered grouping. It improves the lifetime and force utilization of WSNs essentially. PEACH convention supporting area mindful directing (which gives area data of sensor hubs) has most minimal force utilization of the various conventions. It produces groups which are static and fixed and accordingly steady. In light of caught data, it structures groups with no extra bundle transmission of notice, declaration, joining and planning messages.

C) HEED:

HEED implements multi-hop router mechanism. The main modules of multi-hop router are [16]:

1 Routing Engine: This module mainly controls everything in HEED router. Its task is to decide whether a packet should be forwarded to parent of the tree or pushed onto protocol stack.

2 Routing Rationale: The system needs to choose a directing calculation for sending bundles. This unit chooses the directing calculation to be utilized. It structures the system into associated diagram, keeps up data of neighbor hubs and sends update messages fro tree development. This comprises of 2 primary modules:

a. Clustering Logic:

This unit actualizes the chose grouping calculation.

b. Parent Choice:

This module gauges interface cost for each neighbor dependent on nature of interchanges and its closeness to the Base Station.

D) EECML

As talked about EECML [8] convention by Xiang Min and group is planned in a way that the CH goes about as the nearby control community rather than as often as possible changing the bunch head so as to adjust the heap. CH is troubled with transmitting information from different CHs through multi-bounce, along these lines the vitality dispersal of the CH is substantially more than that of the general hub. Clearly, to keep up the availability of the whole system, it is significant that the CHs closer to the Base station save alive as far as might be feasible for the inter cluster correspondence. So the quantity of the hubs in the groups nearer to the BS should be littler than those more remote away from the BS [17, 18]. Accepting n sensor hubs are conveyed in a wedge V territory with edge called the grouping point, and the hubs are sent with uniform thickness (hubs/m2). V is apportioned into m rings V1, V2 , . Vm. Each ring signifies a bunch, and the inside separation between the two adjoining rings is d1, d2, . , dm , and di (1<=i<=m) is a one-bounce separation for between group correspondence, for example the group nearer to the BS is known as the upper layer bunch and other is known as the lower layer group.

## IV. SIMULATION

For LEACH, PEACH, HEED and EECML protocol we have used Matlab Simulator A simulation environment having 50nodes,100nodes in 500 x 300 flat grid has been created with random position.

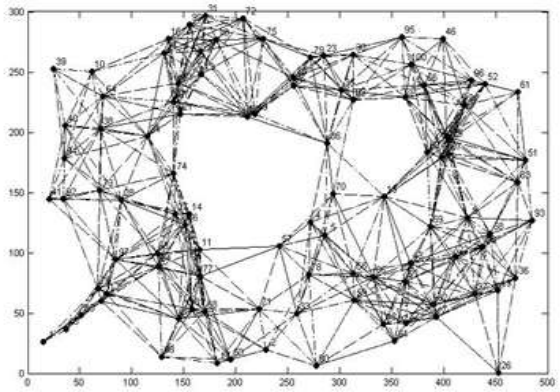

Fig 2: Deployment of 100 nodes

Cluster Head:

Cluster Head is whole responsible for delivering the packets to intended destination. Random and uneven distribution of cluster heads in Leach makes the Network overloaded.

Total number of nodes alive:

This metric indicates the overall lifetime of the network. More importantly, it gives an idea of the area coverage of the network over time. LEACH is a proactive routing protocol hence the number of alive nodes is higher as compared to the HEED protocol. In LEACH all nodes need to be active in forwarding the packet. But in HEED is a reactive routing protocol, so the required number of nodes who has the idea about the destination nod will take part in the communication. In PEACH as it is dealing with hybrid network the number of alive nodes will be high as compared to the other algorithms. Whereas EECML is a protocol for pure reactive network in which hub life time is increased.

Total No of the Dead Node:

Dead node is nothing but the routing holes present in the communication path. Routing hole means the node which takes part in the communication path goes dead during the communication of the packet. In LEACH the number nodes taking part in the communication is higher as compared to the number of nodes taking part in the communication in HEED protocol. In EECML the number of dead nodes is high but in PEACH it is less as compared to the HEED protocol.

Number of packet to Base Station:

Base station is nothing but the node present under one cluster head. Due to the proactive nature of LEACH protocol the packets will be transmitted to the large number of Base Station where as due to reactive nature of the HEED protocol packets will be transmitted to the fewer number of Base stations. In EECML higher number of nodes are included during the communication hence the number of packets forwarded to the BS is high but in PEACH it becomes less.

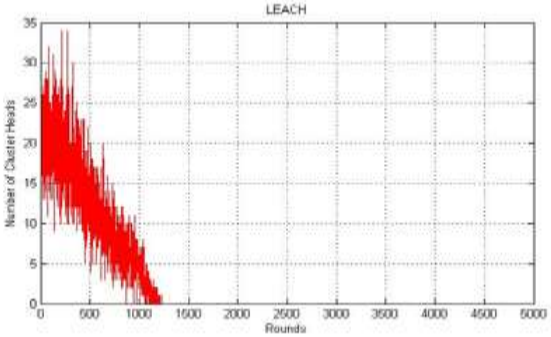


Fig 3: Number of CH of LEACH

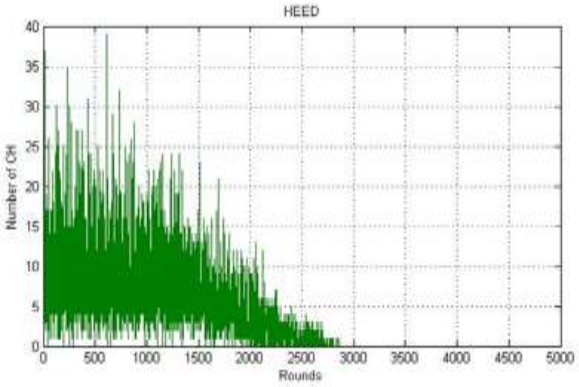


Fig 4: Number of CH of HEED

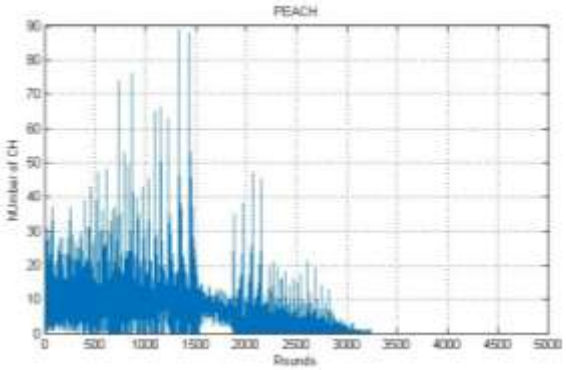


Fig 5: Number of CH of PEACH

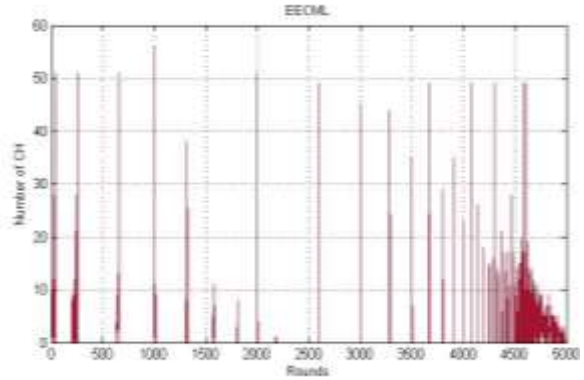


Fig 6: Number of CH of EECML

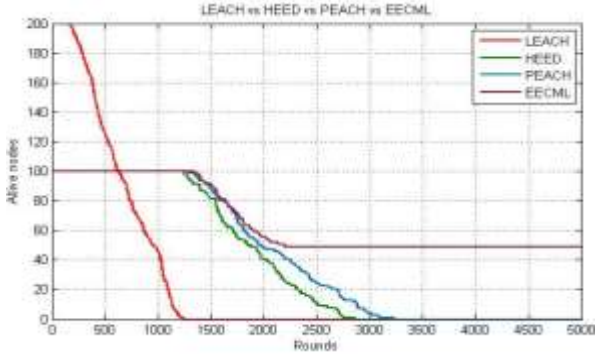


Fig 7: Number of Alive Nodes of LEACH vsHEED vs PEACH vs EECML

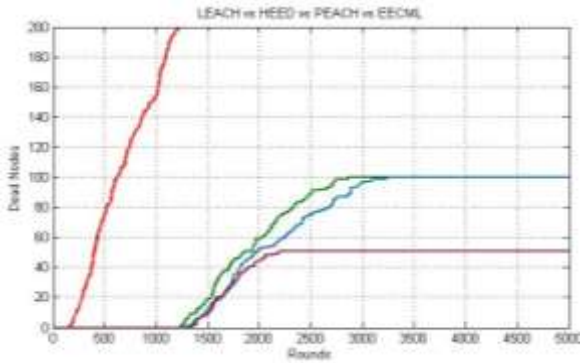


Fig 8: Number of Dead Nodes of LEACH vsHEED vs PEACH vs EECML

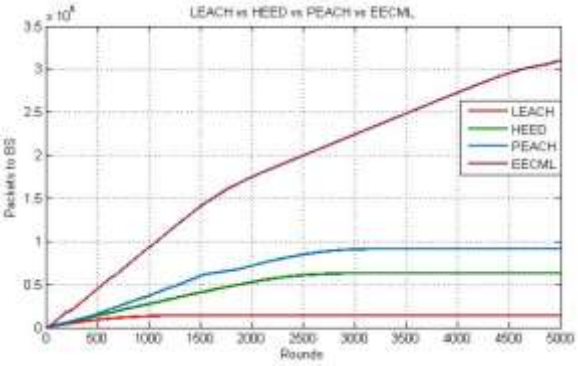


Fig 9: Number of Packets to BS of LEACH vsHEED vs PEACH vs EECML

## V.CONCLUSION

In this thesis work we have studied the LEACH, HEED, PEACH and EECML protocol. Performance for all the protocols has been evaluated in MATLAB software. Few influencing parameter such as Cluster Head, Number of Dead Node and Number of Alive Nodes has been calculated for 5000 number of rounds execution.

The main purpose is, whenever a Base Station fails, and a new Base Station takes the charge, re-clustering has to be done, but new clusters formed should not be completely different so that later when security algorithm acts on the updated cluster, the overhead reduces to minimum. Therefore, after the detailed study, it can be inferred that mentioned six metrics decide the extent of adaptability in the clustering algorithm. Specially, it has been observed that the more the cluster stability and less the cluster overlapping, the more will be the network reliability. Also power consumption has become a significant factor for improving network lifetime. Even though energy depletion of CH in EECML is faster as compared to that in HEED, the total power consumption of sensor network in EECML is much less as compared to HEED. Therefore, considering the overall network, the above factors and results obtained, it can be concluded that EECML is the appropriate choice of clustering algorithms to achieve high adaptability in Wireless Sensor Network upon failure of BS.

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