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Development of a naive Routing Protocol based on Regional Energy Efficient Cluster Heads for WSNs

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ABSTRACT

In this paper, we propose Regional Energy Efficient Cluster Heads based on Maximum Energy Routing Protocol for Wireless Sensor Networks (WSNs) . The main purpose of this protocol is to improve the network lifetime and particularly the stability period of the network. In REECH-ME, the node with the maximum energy in a region becomes Cluster Head (CH) of that region for that particular round and the number of the cluster heads in each round remains the same. Our technique outperforms LEACH which uses probabilistic approach for the selection of CHs. We also implement the Uniform Random Distribution Model to find the packet drop to make this protocol more practical. We also calculate the confidence interval of all our results which helps us to visualize the possible deviation of our graphs from the mean value.

Keywords: Wireless Sensor Networks (WSNs) , Routing protocol, Cluster heads on the basis of maximum energy, Packet Drop, Confidence Interval.

I. INTRODUCTION

A Wireless Sensor Network (WSN) can be receptive or proactive. In later case, hubs send their information to the Base Station (BS) or Cluster Head (CH) just when they recognize a change and keep the transmitter off when they don't recognize any adjustment in the climate. Our proposed convention is proactive. This methodology is more energy proficient as think about to the responsive conventions. As in receptive conventions, hubs keep sending the information to the BS constantly. In this way, they rapidly expend their energy when contrasted with the proactive conventions

In proposed convention, the BS is at the focal point of the field, i.e, on the off chance that the zone of the organization is 100mx100m, the BS would be at a position (50m, 50m).

By the term homogenous, we imply that at first all hubs in the organization have a similar measure of energy. Like Drain [1], REECH-ME is likewise founded on the homogenous set of hubs. Everything relies upon the steering strategy that how proficiently it expends this energy to build the existence time and especially the strength time of the organization.

Bunching might be static or dynamic. In Static Clustering the bunches are not changed all through the organization life time.

While in Dynamic Routing, the groups change depending on the organization attributes. Drain utilizes Dynamic Clustering and its CHs are picked on probabilistic premise. So the number of its CHs and the size of the groups may change after each round. That is the reason its number of CHs isn't ideal.

So the quantity of parcels shipped off the BS is additionally not fixed as they rely on the quantity of the CHs.

In the proposed conspire, the absolute zone is partitioned into 9 districts. These are named as R1, R2, R3, ... , R9 as appeared in Fig. 2. The area R1 is nearest to the BS and uses Direct Correspondence as its directing method. In Direct Communication, each hub sends its information straightforwardly to the BS. All different locales, i.e R2 - R9, don't utilize Direct Communication.

Rather, they structure CHs to send their information to the BS. REECHME utilizes Static Clustering, so bunches all through the organization lifetime continue as before. Every district aside from R1 is known as a group and each bunch has just a single CH for a specific round.

Different hubs of locales R2-R9 send their information to the BS through CH of their locale. In our convention, the CH is picked on the premise of greatest energy. It implies that in any round the hub having the most extreme energy turns into the CH. So the energy use turns out to be effective just as the quantity of the CHs in a round gets fixed. As there are 8 locales which structure bunches, so there would be 8 CHs in each round which is the ideal number.

As in any genuine case situation, the quantity of parcels got at the BS is never equivalent to the quantity of parcels shipped off the BS. This is on the grounds that a few parcels are lost because of certain factors. Those components may incorporate impedance, lessening, commotion, and so forth. That is the reason we utilize the Uniform Random Distribution Model [5] for the count of bundles drop. This makes REECH-ME more commonsense.

We additionally ascertain the Confidence Interval of every one of our outcomes. It encourages us to picture the deviation of the charts from the mean worth. Where, the mean worth is determined by taking the consequences of 5 recreations, and afterward taking their mean.

II. MOTIVATION

The main objective of a routing protocol is to efficiently utilize the energy of the nodes. This is because these nodes are not rechargeable and in order to make them useful for a longer period of time, routing protocols have been proposed. Routing protocols improve the lifetime of a network and specifically 2 the stability period of a network. Protocols [1] , [6] , [7], [11], [12], [13], [17], [18], [19] and [20] are proposed to achieve these goals. As shown in Figure 1, LEACH uses dynamic clustering. Hence, its clusters change after every round.

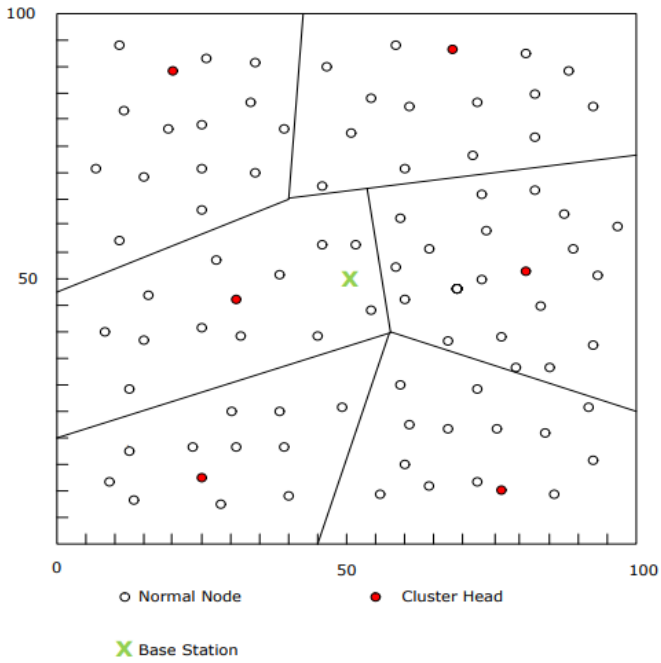

Fig. 1. Clustering in LEACH Protocol

As the CH determination in LEACH is based on likelihood, the ideal number of CHs isn't accomplished. So the energy is not proficiently used. The region inclusion in LEACH is moreover not extremely effective. This is on the grounds that it regards the entire zone as a solitary region and the hubs are conveyed in it immediately. So a portion of the region is left unattended. To productively use the energy and to improve the inclusion region, numerous analysts have presented some viable methodologies [2] , [3] , [4] and [10]. In these methodologies, the complete zone is separated into little locales and these areas are dealt with independently for the hubs dissemination and it improves the territory inclusion. In our convention, we likewise utilize the methodology of isolating the complete zone into littler regions. We utilize the immediate transmission for the territory (R1) nearest to the hubs as appeared in Fig. 2. We utilize the static grouping in every single other district. The CH choice depends on the most extreme energy of a specific hub in a round. It implies that the hub with the most noteworthy energy is picked as the CH for that specific round. So the energy is productively used and the region inclusion is likewise improved.

$$d_o = \sqrt{\frac{\epsilon_{fs}}{\epsilon_{mp}}} \quad (1)$$

if $d < d_o$

$$E_{Tx}(k,d) = E_{elec} * k + \epsilon_{fs} * k * d^2 \quad (2)$$

if $d \geq d_o$

$$E_{Tx}(k,d) = E_{elec} * k + \epsilon_{mp} * k * d^4 \quad (3)$$

Reception Energy:

$$E_{Rx}(k) = E_{elec} * k \quad (4)$$

Where E_{elec} is the energy dissipated per bit to run the transmitter or receiver circuit, ϵ_{fs} and ϵ_{mp} depend on the transmitter amplifier.

III. THE REECH-ME PROTOCOL

A productive steering convention is the one which devours least energy and gives great inclusion zone. Least utilization of energy leads towards better organization lifetime what's more, especially the steadiness time frame. Though great inclusion zone is helpful in getting the necessary data from the entire organization territory. Since, supposing that the inclusion zone isn't acceptable, at that point their future some little zones left unattended in the network. These unattended regions are alluded to as inclusion gap. The essential target of a steering convention is to accomplish least energy use and full inclusion territory. Numerous explores have tended to such issues as in [2] and [3].

Various methodologies are utilized to take care of this issue, one of which was the division of the organization field zone into sub zones.

In the proposed strategy, we partition the organization region into sub zones as clarified in the accompanying subsection.

A. Development of Regions

In LEACH, the CHs are chosen on probabilistic premise and limit is determined for every hub. Bunch is shaped on the premise of got signal quality from the CH and its partner hubs. In our convention, we partition the zone in various locales as appeared in Fig. 1. Above all else, the entire territory is separated into two concentric squares. The internal square is itself a locale and is alluded to as Region 1 or R1. The external square is separated into 8 districts, 4 of which are square shapes and 4 are squares as appeared in Fig. 2. The limits of all areas are taken as:

- R1 - (25 - 75, 25 - 75)
- R2 - (50 - 100, 75 - 100)
- R3 - (0 - 25, 75 - 100)
- R4 - (0 - 25, 50 - 75)
- R5 - (0 - 25, 25 - 50)
- R6 - (0 - 50, 0 - 25)
- R7 - (50 - 100, 0 - 25)
- R8 - (75 - 100, 25 - 50)
- R9 - (75 - 100, 50 - 75)

Each region contains fixed number of nodes. R1 contains 20 nodes, whereas, regions R2-R9 contain 10 nodes each. The BS is located at the center of the field. Fixed number of nodes are randomly distributed in their defined regions.

IV. RADIO MODEL

REECH-ME assumes a simple first order radio model in which the radio dissipates Eelec = 50 nJ/bit for powering the transmitter or receiver circuitry and Eamp = 100 pJ/bit/m2 for the transmit amplifier to achieve an acceptable Eb/No. Transmitter circuitry also consumes EDA = 50 nJ/bit to aggregate the data received by the normal nodes. We also take in account the d 2 energy loss due to channel transmission. Thus, to transmit a k-bit message distance d the energy is given as:

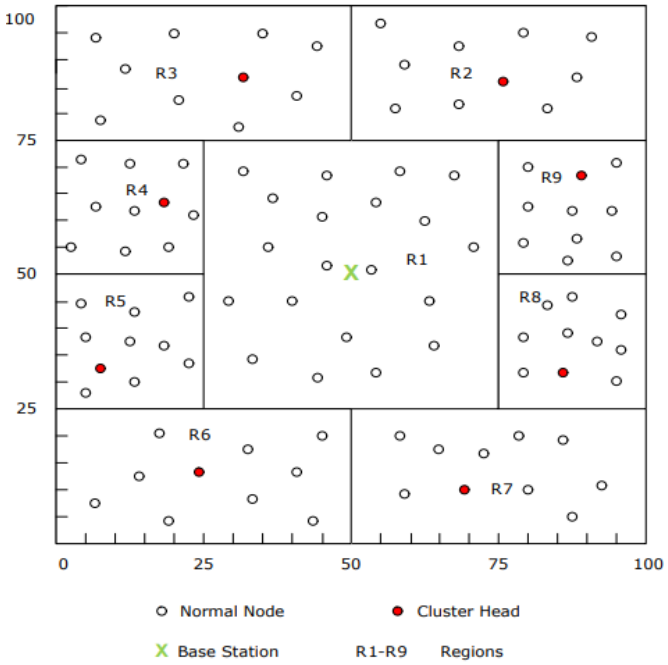

Fig. 2. Regions in REECH-ME

CH Selection

Not at all like LEACH in which the CHs are chosen on probabilistic premise, REECH-ME chooses a hub as the CH of that area on the off chance that it has the greatest energy before the beginning of that round.

All different hubs send their information to CH which gets the information from all the hubs, totals it and sends it to the BS. When the first round is finished, the measure of energy in each hub would not be the equivalent. This is on the grounds that the use of energy relies on the separation between the hub/CH which is sending and the CH/sink which is getting.

The bigger the separation, the more prominent energy is expended. What's more, littler the separation, littler energy is devoured. As separation

for transmission and gathering is distinctive for various hubs, the energy utilization will likewise be diverse for various hubs. For each next round, the CH is chosen based on their energies. The hub with the most extreme energy in a district turns into the CH of that district for that specific round. All the locales aside from R1 will follow a similar strategy of CH determination.

V. RESULTS

In this part, we survey the exhibition of our convention utilizing MATLAB. In our convention absolute region is isolated into 9 areas. District 1 uses direct correspondence as its steering procedure. Though, all different areas use grouping which is in view of most extreme energy of a hub in that specific area. The hub with the greatest energy in a specific district turns into the CH of that locale. Typical hubs of an area send their detected information to BS by means of CH of their own district. In this way, after each cycle, another hub which has the greatest energy in that area is picked as the CH of its locale. The reenactment boundaries are given in Table 1.

Table 1 Parameters used in Simulations

Parameter	Value
Network Size	100m x 100m
Node Number	100
Initial Energy of Normal Nodes	0.5J
E_{TX}	50nJ
E_{RX}	50nJ
E_{DA}	5nJ
Packet Size	4000 bits
Probability of Packet Drop	0.3
Sink Location	(50m,50m)

A. Execution Parameters

In the accompanying subsections of execution boundaries, we will talk about certainty stretch, network lifetime, throughput also, bundle drop.

1) Confidence Interval: The hubs are haphazardly circulated in a specific district. They might be put anyplace in a specific district. Any new circulation change the area of hubs in network zone. Thusly, the computations with respect to their lifetime, soundness, unsteadiness area, bundle drop, and so on. somewhat fluctuate. Thus, remembering this reality, we additionally determined the certainty timespan our outcomes. Certainty stretch encourages us to imagine the deviation of the charts from the mean esteem. Where, the mean worth is determined via doing the reenactments for multiple times, and afterward taking their mean. We compute the certainty timespan our charts.

2) Network Lifetime: Alive hubs allude to those hubs which have adequate energy to detect and communicate information. The lifetime of an organization relies on the quantity of alive hubs. However long there is even one alive hub in the organization, its lifetime checks. So the lifetime of an organization alludes to the time period from the beginning of the organization till the demise of the last hub. Above all else, we contrast the lifetime of LEACH and our REECH-ME. The Fig. 3 shows the certainty timespan what's more, alive hubs. We ascertain the certainty stretch in light of the fact that it causes us to envision the deviation of the chart from its mean esteem. Though, the mean worth is determined via completing 5 recreations and afterward taking their mean.

Fig. 3 shows the quantity of alive hubs. It tends to be seen that the organization lifetime of our convention is 66% more than that of the LEACH, i.e, around 2500 and 1500 adjusts separately.

The steadiness period is a period term from the beginning till the demise of the main hub. The soundness time of our convention is 79% better than

the LEACH. REECH-ME utilizes greatest energy based CH determination. While in LEACH, the bunching depends on the likelihood.

Greatest energy based bunching assists with using the energy of just those hubs which have the greatest energy in their locales. So the energy of all hubs is proficiently used.

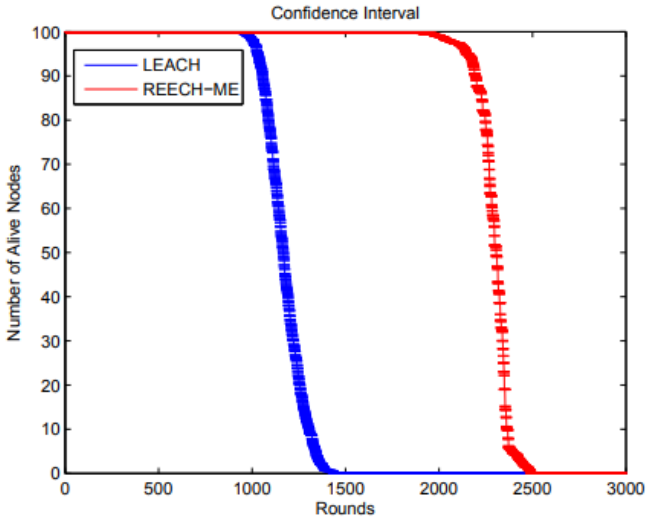

Fig. 3. Number of Alive Nodes

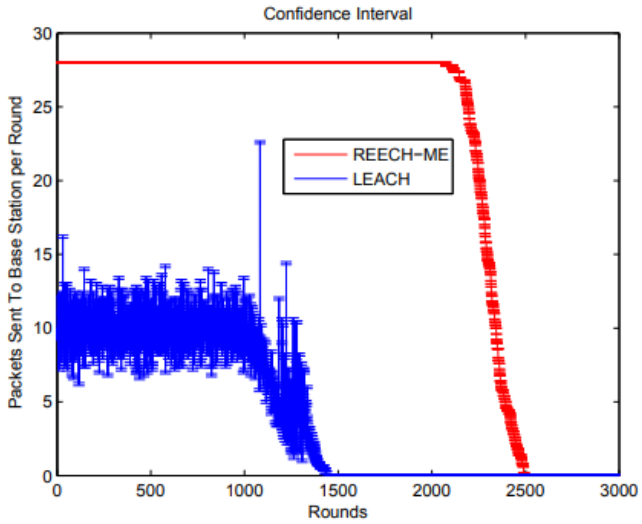

Fig. 4. Number of Packets Sent to BS Per Round

We generally get the ideal number of CHs in a round, i.e 8 since we partition the entire zone into 9 littler districts. What's more, 8 areas use grouping and every locale has just a single CH. So the quantity of groups and CHs is constantly fixed. While in LEACH, the quantity of CHs is rarely the equivalent and consequently, the energy usage isn't productive.

3) Packets Sent to BS: The normal bundles shipped off the sink in LEACH are less when contrasted with REECH-ME as appeared in 10 CHs (not in every case precisely 10) in a round. What's more, we know that the typical hubs don't send their information straightforwardly to the sink. Rather, they send their information to the BS by means of the CH. So on a normal, there would associate with 10 parcels sent for each round. Though in our Protocol, 20 hubs are available in the district which is nearest to the sink and they send their information legitimately to the sink. In the wide range of various 8 locales, 8 hubs would be CHs in each round. Thus, on a normal there would be 28 bundles sent per round. As the quantity of the dead hubs expands, the quantity of parcels shipped off the BS diminishes.

4) Packet Drop: Ideally when a CH sends its information to the BS, all the bundles are gotten effectively with no misfortune, i.e, the quantity of bundles shipped off the BS are equivalent to the number of bundles got at the BS. Yet, as a general rule it does not occur. At whatever point the information is shipped off BS from a CH, a portion of its bundles don't arrive at the objective. This is called Bundle Drop. The purpose for this bundle drop might be the obstruction, weakening, commotion, and so forth. In our convention, we have actualized the uniform irregular circulation to determined the bundle drop. This makes our convention more down to earth. We utilized 0.3 as the parcel drop likelihood esteem. Fig. 5 shows the number of parcels shipped off the BS per round, while, Fig. 4 shows the quantity of parcels got at the BS. It very well may be seen that the quantity of parcels got at the BS is less than the quantity of parcels shipped off the BS. Subsequently,

bundle drop makes our convention more appropriate and useful also.

In a perfect world, at whatever point the information is shipped off the sink, it comes to with no bundle misfortune. In any case, in genuine circumstances this ideal condition doesn't exist. That implies that when information is sent to the sink from the CHs, a few bundles are lost. To show this bundle misfortune, we utilize the Uniform Random Distribution Model to discover the parcel drops. We compute the parcel drop by taking the bundle drop likelihood as 0.3 and afterward compute the certainty span as appeared in Fig. 5.

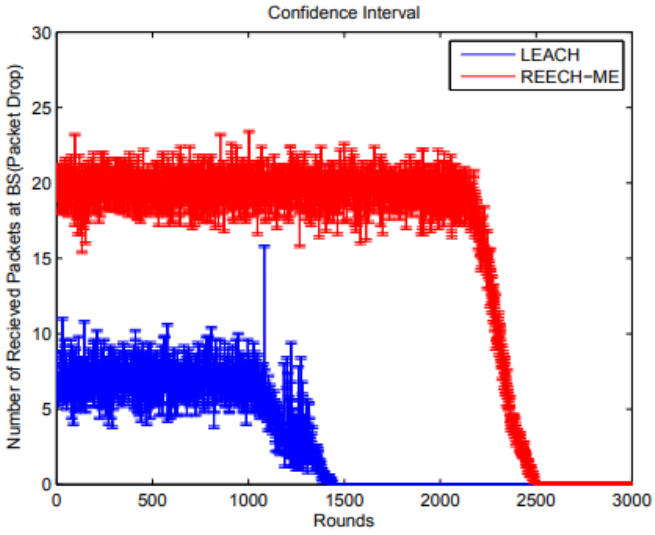

Fig. 5. Number of Packets Received at Sink after Packet Drop

Because of the bundles drop, the quantity of bundles that is gotten at the sink would be less when contrasted with the quantity of bundles sent by the CHs. So in our convention, the quantity of bundles got at the BS varies around 20 bundles. While in LEACH, the number of bundles got at the BS changes around 7. The number of got bundles diminishes as the quantity of dead hubs increments. As the soundness district of LEACH is littler when contrasted with our convention, the quantity of got bundles begins to diminish from around 1000th round. Though in our convention, this decrement in the quantity of the got bundles begins from around 1800th round. In REECH-ME the normal number Figure 6. The quantity of parcels dropped in REECH-ME is more when contrasted with the quantity of parcels dropped in LEACH. Also, the explanation for it is that in REECH-ME the normal number of parcels which is sent to the BS is more than that of the LEACH. The 0.3 likelihood on both the conventions will bring about various number of bundles dropped in the two conventions.

VI. CONSLUSION AND FUTURE WORK

Our proposed strategy utilizes static bunching and CHs are chosen based on the greatest energy of the hubs. This outcomes in fixed number of CHs in each round and the ideal number of CHs is additionally kept up. We actualized Bundle Drop Model to make our convention more viable. We likewise actualized certainty stretch to locate the conceivable deviation of our diagrams from the mean worth, where mean worth is determined by reenacting our convention multiple times and afterward taking its mean. We contrast the consequences of our convention and that of the LEACH. REECH-ME beats LEACH in network lifetime, soundness period, zone inclusion and throughput. Hence, this plan improves the ideal credits, i.e, least energy utilization, greatest soundness period, better lifetime what's more, throughput dispense as contrasted and LEACH.

In future, Routing Link Matrices can likewise be applied on this proposed strategy. Directing should be possible by adjusting various methodologies as done in [14], [15] and [16].

Use of Routing Link Matrices on the proposed plot can be helpful in accomplishing effective utilization of energy in the organization.

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