CURRENT ENERGY ALLOTED TSEP (CEATSEP) IN WIRELESS SENSOR NETWORKS

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ABSTRACT - *With WSN elevation in various fields, has made this leading technology to come across with some stumbling blocks. The main obstacle of the WSNs includes power conservation, knot life, stability and transmission of network and the knots. The Congregation is new to the sustainability of the network. To make the network model more energy-saving, we need to reduce energy spending, which is among the important issues in WSNs [1, 2]. CEATSEP provides the idea that cluster head selection can be different by multiplying the probability with a new factor, which is the ratio of the node's total energy with the total energy of the network. It elects the CHs on the basis current energy level of the knot. Working of this protocol has been proved and the results obtained are compared to the old TSEP. CEATSEP simulation is done using MATLAB and states that it works better than the Threshold Sensitive Stable election Protocol (TSEP) at the time of stability and network life. It is also found that stability has been increased by 91% compared to the TSEP and more than twice the SEP. The CEATSEP overall lifestyles have also been increased 50% compared to TSEP.*

INTRODUCTION:

Clustering is widely adopted in data collection in WSN, where the coherent network is alloted with several groups. Clusters have CHs to collect data from all other nodes and send them to a location or Sink. It holds benefit of low power utilization, a simple routing program and good scalability, and somehow reduces power loss issue. It has merit of low power utilization, simple routing and good extensibility, and reduces the risk of loss of energy on one side or another.

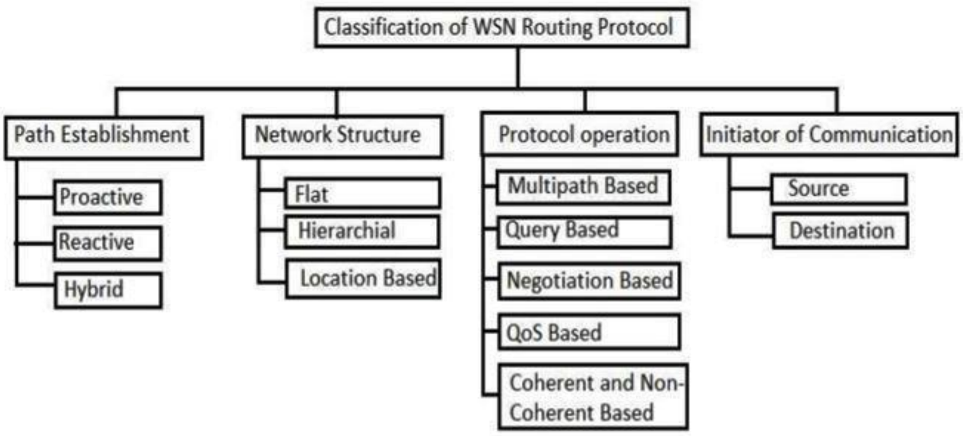

Figure 1. Classification of WSN Routing Protocol[22]

Majority of the routing protocols in WSN work on these kind of network, where all the knots are analogous to power and hardware configurations. However, due to changes in node resources and potential network topology changes, different sensor networks are actually more effective. It is well known that the presence of more power nodes increases trustworthiness and network life [3]and portrays a significant role while choosing the head of a cluster. Nowadays searches are focusing on node's location and connectivity.

Selected CHs in [4] have been set to possess minimum composite distance between CHs and the Sink. In [5], CHs election rely on the residual power level of sensor knots for transmission. While [6] demonstrates the foremost cluster-based clustering technique to select the leaders as well as reduces the problem of energy loss. Density-based WSN clustering protocol [7] improves LEACH as a function of rectal density and by Heterogeneity of knots. SEP [8] protocol defines duplet of nodes based on the energy residue and onset energy in each node.

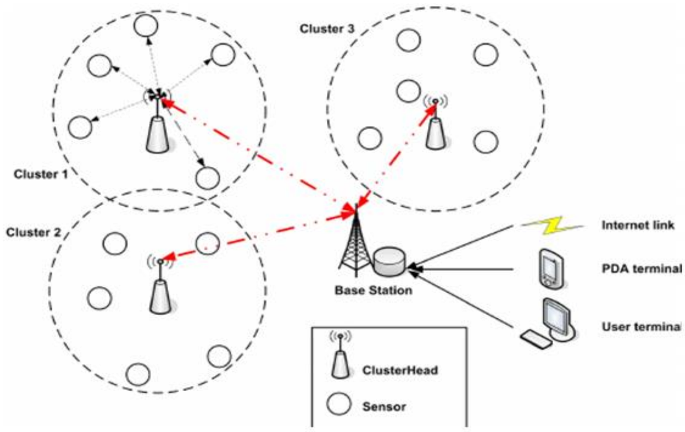

Figure 2: data aggegrigation in wsn.

In [9], the Cluster leaders are elected on the basis of the probability of the total power remaining in each knot and the network's total energy. The CHs in [10] communicate data and does data fusion respectively. Knots have high chance of becoming a node cluster head which possess high-end energy, low transaction costs and more robust data processing capabilities. In [11], the weight of each node is determined by the possibility of becoming the head of the cluster which in accordance with rest of the energy in a knot.

The CH determination Protocol for WSN [12] is effective and depends on the remaining energy that is local (cluster) information in sensor knots, without the need for overall consciousness of remaining network energy. Ineffective usage of available power results in poor execution and a short life cycle of the network. The energy of these sensors is a very low resource and it needs to be systematically managed. The proposed protocol, which is an extension of the Enhanced Threshold Sensitive Election Protocol (TSEP-E) [13], understands the residue energy and guarantees maximum network power. Simulation results say that the presence of diversity of the energy improves network efficiency as well as its performance.

RELATED WORK

1). LOW-ENERGY ADAPTIVE CLUSTERING HIERARCHY & STABLE ELECTION PROTOCOL.

LEACH makes sure that each knot can be elected as CHs once every "$1/P_{opt}$" cycle. [15].In this routing protocol, the knots are homogeneous, having optimum percentage 'P_{opt}' of knots n that can become CHs each turn, but the theory ceases to hold when LEACH is used in the existence of heterogeneity. As Soon as the opening knot finishes, the system inconstancy is high and the cluster process becomes uncertain. [16] In fact, "P_{opt}" is only compatible when the network population is stable and the starting value is equal to n.

The issue of system inconstancy has been eliminated by other authors by introducing a new protocol in WSN called SEP [8]. The protocol uses two types of nodes: normal knots m and advanced knots α. Advanced knots keep α times additional power than normal knots and tend to overtake normal knots in qualifying as CH during the same round. In SEP, the initial energy of nodes depicts a supreme role in determining the probability of choice. The weighted probability for the normal and advanced nodes shown below calls extra energy added to the network. Total initial energy and probabilities are as follows:

$E_{total} = nE_0(1 + m\alpha)$ --------------------1

$P_{nrm} = \frac{P_{opt}}{1 + m\alpha}$ -------------------------------2

$P_{adv} = \frac{(P_{opt})(1 + \alpha)}{1 + m\alpha}$ -------------------------3

In equation E_{Total} is the total initial power 2&3 P_{nrm} is the weighted probability for the normal nodes , P_{adv} is the weighted probability for the advanced nodes, m is the proportion of the advanced nodes with α times more energy than the normal nodes.

Therefore, the first improvement in the LEACH includes various energy levels for the node, i.e the advanced knots and common knots, while the second improvement is to increase the cycle of sensor network in accordance with the leap in power. Therefore, SEP is a better version of the LEACH, has emerged as an optimal and well dispersed design for providing additional power plugs in the network, which is a source of heterogeneity. SEP uses two-level ranking nodes in case of node's energy. It is also believed that knots are not ambulant and are evenly strewed over the detection region .We define the threshold T_{snrm} for normal nodes and T_{sadv} the threshold for advanced knots that are as:

$$(T_{snrm}) = \frac{P_{nrm}}{1-P_{nrm}\left(r_{mod}\cdot\frac{1}{P_{nrm}}\right)} \; if \; s_{nrm} \in G' \text{----------------- } 4$$

$$0 \; otherwise$$

$$(T_{sadv}) = \frac{Padv}{1-P_{adv}\left(r_{mod}\cdot\frac{1}{P_{adv}}\right)} \; if \; s_{nrm} \in G'' \text{ ---------------------}5$$

A lap is the time interval for all knots to send the data to their CHs; the heads of the groups compile the data and inform the sink; This set of rounds is a time energy of the network. Subsequently, SEP addresses the heterogeneous energy impact of nodes in WSN grouped hierarchically. An important feature of this approach is that the group leader is to adapt the likelihood of preference heterogeneous configurations. Initially, advanced nodes are supplied with more power than normal nodes. SEP extends the stability period, which is interpreted as the time interval before the death of the first node.

2). ENHANCED STABLE ELECTION PROTOCOL (ESEP)

In a supplement to the SEP there is Enhanced Stable Election Protocol (SEP-E)[6] to disperse power effectively and strengthen network life to maximal. This very WSN has heterogeneity management of three levels and identifies three class of knots that are advanced knots, intermediate knots, and normal knots. Where normal knots are nodes with less energy and a portion of knots with greater energy than normal knots are advanced, while energy nodes between normal and advanced knots are called intermediate knots. Therefore, b represents the number of intermediate knots and μ times larger than the normal nodes.

In enhanced SEP, [6] energy of regular nodes is E_0, advance knots $E_{adv} = E_0(1+\propto)$ and for intermediate nodes is calculated as $E_{int} = E_0(1+\mu)$ where $\mu = \alpha/2$ .Thus the total energy of normal nodes, advanced knots and intermediate nodes will be $nb(1+\alpha)$, $nE_0(1-m-bn)$ and $nmE_0\,(1+\alpha)$ respectively. Therefore, the total energy of all nodes will be $E_0(1-m-bn) + nmE_0(1+\mu) = nE_0(1+m\alpha+b\mu)$ where n is the number of nodes, m is the ratio of advanced nodes to the total number of knots n with energy above the rest of the knots and b is the ratio of the intermediate knots. Here P_{nrm}, P_{int} and P_{adv} are probabilities of normal, intermediate and advance knots respectively and are given by:

$$P_{nrm} = \frac{P_{opt}}{1+\alpha m+\mu b} \text{ ----------------------}6$$

$$P_{int} = \frac{P_{opt}}{1+\alpha m+\mu b} \text{ ---------------------}7$$

$$P_{adv} = \frac{P_{opt}}{1+\alpha m+\mu b} \text{ ----------------------}8$$

Modified ESEP:

Based on the probability equations for advanced, intermediate, and normal knots illustrated in ESEP, the group header election mechanism is upgraded considering the residual energy of the detection knots[18]. Given in equation (7), the weighted probability for normal nodes is

$$P_{nrm} = \frac{P_{opt}}{1+\alpha m+\mu b} * \frac{E_{residual}}{E_0} \text{ ---------------------}9$$

where P_{opt} signifies optimal percentage of the CHs, α signifies additional power factor in the advanced nodes, μ is the additional power factor in intermediate nodes, m is the fraction of knots chosen as advance one, b is the fraction of knots chosen as intermediate knots, $E_{residual}$ is the remaining energy in sensor nodes after certain rounds and E_0 is the beginning energy of each node.[18] Likewise, the weighted probability for intermediate and advance knots are as:

$P_{int} = \frac{P_{opt}(1+\mu)}{1+\alpha m+\mu b} * \frac{E_{residual}}{E_0}$ -----------------------10

$P_{adv} = \frac{P_{opt}(1+\propto)}{1+\alpha m+\mu b} * \frac{E_{residual}}{E_0}$ -----------------------11

4) SEP-E (RCH):

The head of the current round chosen has maximum energy and minimum distance count. SEP-E (RCH) has a redundant and efficient CH that processes the mechanism for permanent protocol improvement[20]. It first chooses the initial CHS and the initial redundant CHS, and then compares two knots. The best performance node will be selected as the head of the cluster and another node will be a redundant cluster head in the current phase. 4.1 Choosing an SEP-E (RCH) head in the initial cluster will determine the weight of the optimal probability. [20]This weight should be equal to the initial energy of each node divided by the initial energy of the normal node.

Here P_{nrm} is an optimum probability of weight for normal nodes, weighting potential for advance nodes is P_{adv}. P_{sup} is the Possibility of weight optical for Super Nodes [15]

In this work, a better redundant CHs selection mode has been proposed in SEP-E to equity network load and to increase the span of network. In determining the head of a valid cluster, our schema first selects the head of a transient cluster and head of a temporary or unnecessary cluster in each cluster in every cycle. The knot having the maximum energy and minimum distance, has been chosen as the CH. For protocol improvement SEP-E (RCH) is a redundant and effective cluster handler election approach; it first selects the heading of the inceptive cluster head and inceptive unnecessary CH and then compares two nodes. The best performance node will be selected as a cluster header and another node will be an unnecessary cluster heading in the current round. 4.1 Choosing the head of the initial SEP-E cluster (RCH) determines the weight for excellent probability. This weight should be equal to the initial energy of each node divided by the initial energy of the normal node.

We are going to define P_{nrm} a high-weight potential for common nodes, weight before weight is potentially optical weight option for P_{sup} Super Nodes [15]

$P_{nrm} = \frac{P_{opt}}{1+m*(\propto+mo+\beta)}$ -----------------------------12

$P_{sup} = \frac{P_{opt}}{(1+m*(\propto+mo+\beta))} * (1+\beta)$ ----------------13

$P_{adv} = \frac{P_{opt}}{1+m*(\propto+mo+\beta)} * (1+\alpha)$ ------------------14

Where m is the proportion of advanced nodes to the total number of nodes n with energy plus the rest of nodes and $m0$ is the proportion of superknots. The T_{nrm}, T_{sup}, T_{adv} threshold, ds (for normal, advanced and super nodes, respectively, remain the same as [14]).

For a knot s, s generates a random number of $rand(s)$ of $0-1$, $rand(s)$ multiplies a factor representing the remaining power level of a node such as the new random number $rand(s)$.

$rand'(s) = rand(s) * (Emax - \frac{Ecurrent}{Emax})$ ------------------15

Both ICH and RCH use flood modes to transmit status information.

• When ordinary nodes receive status information, they transmit their status information and send the status information of the other nodes they receive.

• ICH and RCH calculate the average distance of all other cluster nodes. Both nodes transmit their minimum KICH and KRCH distance and residual power in the base station.

• The base station receives the information and calculates the weight as follows

2.3 TSEP (Threshold Sensitive Stable Election Protocol) :

This protocol comprises of two parts [9]:

• Its a reactive based routing protocol and Transmission will takes place when it reaches to specified threshold.

• Three different levels of energy discrimination in sensor nodes.

1. Normal Nodes Energy of Normal nodes=E_0

2. Intermediate Nodes Energy of Intermediate nodes= $E_0\ (1+\mu)$

3. Advance Nodes Energy of Advance nodes= $E_0(1+\alpha)$

The optimal Probability of nodes is given as:

$P_{nrm} = \frac{Popt}{1+m.\propto+b.\mu}$ ------------------------16

$P_{int} = \frac{Popt(1+\mu)}{1+m.\propto+b.\mu}$ --------------------------17

$P_{adv} = \frac{Popt(1+\alpha)}{1+m.\propto+b.\mu}$ -------------------------18

ETSSEP

In this section we use the proposed ETSEEP protocol. It is based on TSEP [9]. ETSEP is a reactivity routing protocol based on three-tier clusters. For three levels of diversity, there are nodes with different energy levels: advanced nodes, intermediate nodes and normal nodes. Advanced nodes have a higher power than all other nodes and nodes that have more power than normal nodes and less power from advanced nodes are called intermediate nodes, while the rest of the nodes are called normal nodes. The intermediate node has more energy "b" than the normal node, the advanced nodes have a multiplying energy "a" over the normal nodes and we believe that $b = a/2$. In EETEE, the total energy is divided into different types of nodes, calculated as: For the general node.

TSH routing protocol:

In this article,[21] the authors introduced an effective version of the TSEP protocol, which through the efficient use of sample energy increases the useful life of the network. Evaluate the proposed routing protocol network that works best in terms of life and stability. It proposes an energy-efficient routing algorithm that can reduce power consumption within the network and choose a high-energy node as CH. In order to reduce the shortage of energy during transmission to CH, it includes a hard threshold concept and a soft threshold

Energy for Normal nodes = E_0

Energy for Intermediate nodes =$E_{int} = E_0(1+\mu)$

Energy for Advance nodes = $Eadv = Eo(1+\alpha)$

The optimal probability of nodes:

$P_{nrm} = \frac{P_{opt}}{1+\alpha m+\mu b}$ ----------------------19

$P_{int} = \frac{P_{opt}}{1+\alpha m+\mu b}$ ----------------------20

$P_{adv} = \frac{P_{opt}}{1+\alpha m+\mu b}$ ---------------------21

Calculation of threshold values depending on the residual energy rather than probabilities:

$$T_{nrm} = \frac{P_{nrm}}{1-P_{nrm}(\frac{r_{mod1}}{P_{nrm}})} * \frac{RE_{nrm}}{E_{AVG}} \text{---------------------22}$$

$$T_{int} = \frac{P_{int}}{1-P_{int}(\frac{r_{mod1}}{P_{int}})} * \frac{RE_{int}}{E_{AVG}} \text{-----------------------23}$$

$$T_{adv} = \frac{P_{adv}}{1-P_{adv}(\frac{r_{mod1}}{P_{adv}})} * \frac{RE_{adv}}{E_{AVG}} \text{----------------------24}$$

III. PROPOSED CURRENT ENERGY ALLOTED THRESHOLD SENSITIVE STABLE ELECTION ROUTING PROTOCOL.

Now, to allow CH selection in a modified way, the threshold takes another parameter, which is the relationship between current energy or present energy node and total network energy. Each node generates a random number of 0 and 1 if the generated value is less than the new threshold, this node is CH [1], [12]. Defines cluster heads based on the current energy level of the nodes.

In TSEP energy for normal nodes is E_0, for advanced nodes it is $E_{ADV} = E_0(1+a)$and the energy to intermediate nodes can be calculated as $E_{INT} = E_0(1+u)$ where $u = a/2$, total energy of normal, forward nodes and intermediate nodes will be, $nb(1+a)$, $nE_0(1-m-bn)$ and $nmE_0(1+bu).(a)$ respectively. Then, the total energy of all nodes will be, $nE_0(1-m-bn) + n.m.E_0(1+a) + n.b(1+u) = n.E_0(1+u+a)$

Where n is the number of knots and m is the ratio of advanced nodes to the total number of nodes n with higher energy than the rest of node b is the ratio between intermediate nodes.

$$P_{nrm} = \frac{P_{opt}}{1+am+ub} \text{---------------------25}$$

$$P_{int} = \frac{P_{opt}(1+u)}{1+am+ub} \text{---------------------26}$$

$$P_{adv} = \frac{P_{opt}(1+a)}{1+am+ub} \text{--------------------27}$$

the weighted probability of normal nodes is where P_{opt} stands for optimal percentage of the CHs, a stands for additional energy facet in the advanced knots,u stands for additional energy factor in intermediate nodes,m stands for fraction of the nodes selected as advanced nodes, b is the fraction of the nodes selected as intermediate nodes, P_{Energy} stands for energy retained by the sensor knots following certain rounds and E_0 is the initial energy of each node. For all these types of nodes we have different formulas for calculating thresholds depending on their probabilities, which are shown below:

$$T_{nrm} = \frac{P_{nrm}}{1-P_{nrm}\left(\frac{r_{mod1}}{P_{nrm}}\right)} * \frac{CE_{nrm}}{TOTAL\ ENERGY}\ for\ N_{nrm}\ \mathcal{E}\ G1 \text{---------------28}$$

$$T_{int} = \frac{P_{int}}{1-P_{int}\left(\frac{r_{mod1}}{P_{int}}\right)} * \frac{CE_{int}}{TOTAL\ ENERGY}\ for\ N_{int}\ \mathcal{E}\ G2 \text{-----------------29}$$

$$T_{adv} = \frac{Padv}{1-P_{adv}\left(\frac{r_{mod1}}{P_{adv}}\right)} * \frac{CE_{adv}}{TOTAL\ ENERGY}\ for\ N_{adv}\ \mathcal{E}\ G3 \text{----------------30}$$

Based on the probability of n odes, the threshold is calculated and expressed in equations (23), (24) and (25).

G1, G2, G3 = Group of normal nodes, intermediate nodes and advance nodes consecutively.

CE_{nrm} = Current Energy of Normal Nodes

CE_{int} = Current Energy of Intermediate Nodes

CE_{adv}= Current Energy of Advance Nodes.

$TOTAL\ ENERGY$ = Total power of the network.

Thus the Conveyance takes place from the new CH. Each knot in the WSN should take care of application environment. When the attribute parameters reach the hard threshold, the transmitter will start and the data will be transmitted in the head of the cluster, although this is the first revision when the situation is satisfied or dissatisfied. These values will be stored in the internal variable named Sensed Value (SV). Then, for the second time, the sensor node will only transmit data if the detected value is greater than the threshold value (TH) or if the current search value has a difference and the SV conversion value is equal to or greater than the soft threshold. Therefore, keeping in mind these two thresholds, the number of data transmission cycles can be controlled to save or control the sensor node, because the broadcast will be affected only when the detected value reaches the Hard Threshold (HT). While extra packet data transmissions are directed by a soft threshold, when there is a small change in the value, even less than the interest.

3.1 SIMULATION AND RESULTS:

MATLAB is being used for fructification. Simulation guidelines are given in Table 1, Here 100 sensor knots are apportioned continuous in a rectangle shaped area of 100 meters. 20% of advanced nodes ($m = 0.2$ and $\alpha = 2$) 200% of energy from normal nodes and 10% of the middle node, in which 150% energy is higher than normal knots (Here means is $b = 0.1E\ \mu = 1.5$). Simulation aftereffect show that the revised ESEP routing protocol network works well on the metric of life and performance.

SIMULATION PARAMETERS:

NETWORK PARAMETERS	VALUE
NETWORK SIZE	$100m * 100m$
INITIAL ENERGY OF SENSOR NODES	$0.5J$
NUMBER OF NODES	100
TRANSRECEIVER IDLE STATE ENERGY CONSUMPTION	$50nJ/bit$
DATA AGGREGATION/FUSION ENERGY CONSUMPTION	$5nJ/bit/report$
D_0	$S_{qrt}\left(\frac{E_{fs}}{E_{mp}}\right) = 87.7058\ m$
AMPLIFICATION ENERGY(CLUSTER TO BS) $d \geq d_0$	$E_{fs} = 10pJ/bit/m^2$
AMPLIFICATION ENERGY(CLUSTER TO BS) $d \leq d_0$	$E_{mp} = 0.0013pJ/bit/m^2$

4. SIMULATION &RESULTS:

PERFORMANCE EVALUATION OF OLD TSEP

Fig.3and Fig.4 shows comparison of TSEP and CEATSEP and regarding alive and dead nodes, to number of rounds.

From the analysis of our results, it is found that CEATSEP prolongs the stability period as compared to TSEP [6] algorithms.

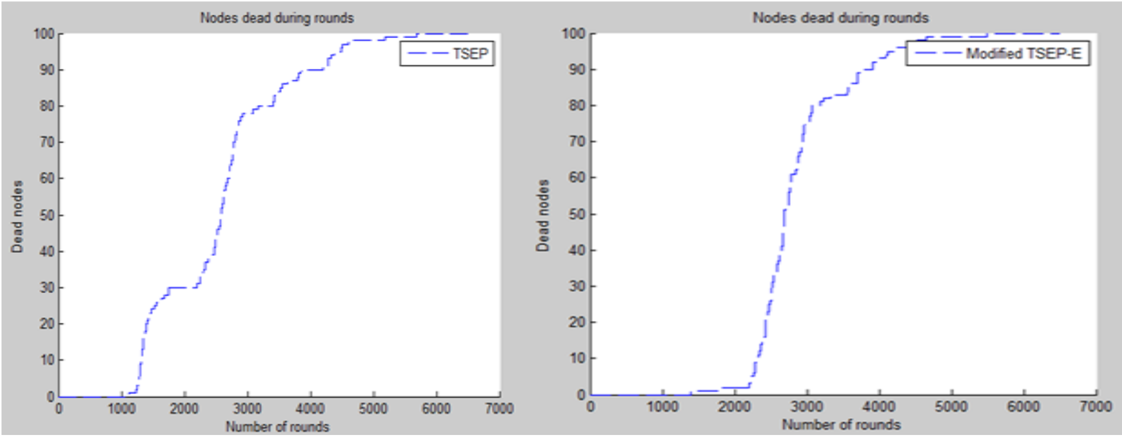

Figure3

Figure 3 shows the number of alive nodes per round, it shows that nodes die more slowly in ETSEP in comparison to TSEP. In TSEP the first node dies at the round number 1121 while in CEATSEP knot expires at 1391. By comparing these results we find that CEATSEP improves the stability period as compared to other protocols.

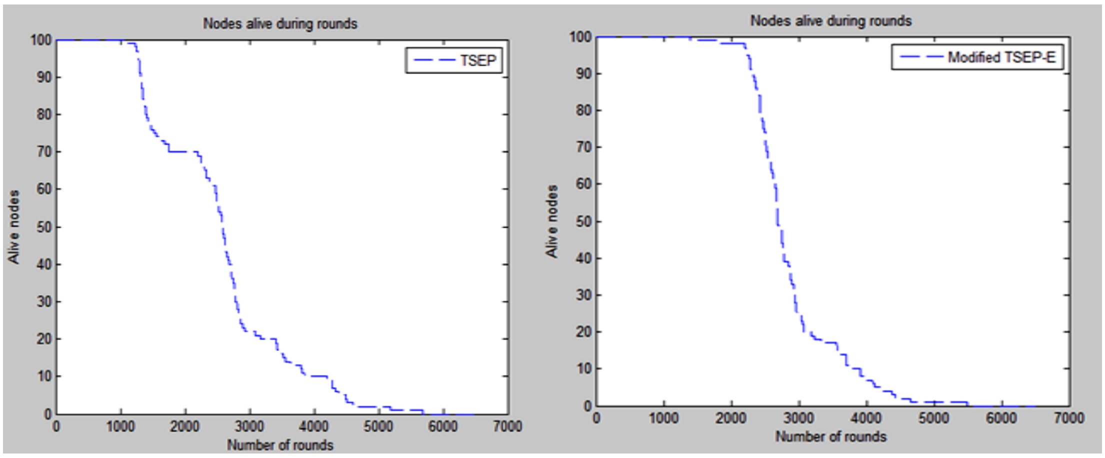

Figure 4

Fig 4 shows the number of dead nodes over the number of rounds, it shows that in TSEP and in CEATSEP all nodes die after 1000 and, shows the lifespan of TSEP and CEATSEP, which indicates that the lifetime of CEATSEP is better than the latter.

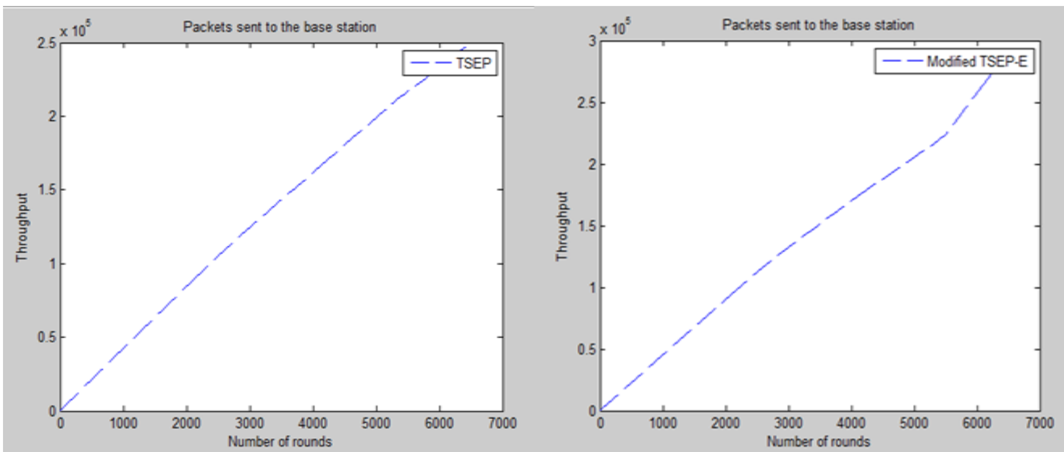

Figure 5

Figures 5 describes the number of packets sent to the base station which is also called the throughput. The number of packets sent to the base station in TSEP and CEATSEP are 316219 and 317444 respectively.

5. CONCLUSION

Below are some of the important features along with modified ETSEP features:

1) Selection of the knots to be a CHs rely on the current activation of the sensor node

Using the equation (23), (24) and (25)

3) Nodes constantly take an environment observation, but communication is not usually done.

4) Users can change features according to the needs, such that the qualities are always sent when the cluster changes.

5) It is still a probabilistic algorithm, working precisely on the knot energy and ultimately elects the knots on the basis of energy rather by potential possibilities.

The algorithm proposed is a routing protocol called modified TSEP which selects the nodes with the highest current energy as CH, for this a supplementary parameter was introduced in the TSEP for picking out CHs. This paper helps in finding better solutions to the known issues of WSN sensitive routing protocols. Simulation results corroborate the statements about the effectiveness of the proffer contrivance when measured in case of current energy of knots in the WSNs and period of network stability. It is believed that our algorithm overcomes its contemporary algorithms, namely the TSEP-E, which can be attributed to the proposed changes, so we can conclude undoubtedly that the urged CEATSEP addresses a broader range of applications and achieves the objectives of our study.

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