Multi-Objective Clustering Protocol for Heterogeneous Wireless Sensor Network

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Abstract—As we know the capabilities of communication system seems to be extended to greater level with the integration of wireless sensor network (WSN). Seamless control of real-time application has been possible. But, an energy constraint of sensor node limits the lifecycle of the activity. Thus, it is necessary to utilize the available energy efficiently to prolong the lifetime of sensory system. Secondly by adding Heterogeneity in WSN and by controlling the communication activity it is possible to extend the lifetime of the network multifold. Thus, it is possible to improve energy efficiency of WSN without constraints of deployments, responsibility and heterogeneity level. So, design perceptive based on multilevel clustering scheme for varied objectives is the better choice for proposed scheme. As clustering scheme reduces internal traffic, efforts of communication and improve the load balancing over the network. Here, we propose Multi-objective (MO) clustering protocol for Heterogeneous WSN to enhance the energy efficiency of deployed network. We hereby found that proposed scheme work better for varied deployment condition and for various performance parameters. Simulation results of proposed design outperform the well-known published protocols by more than 1.97 times.

Keywords—Node degree, sink, Receive Signal Strength, Multihop, Node Index, optimum.

1. INTRODUCTION

Sensory system is the integral element of intelligent communication system. As, ease in remote event monitoring is possible with sensory system. But, limited energy resource of sensor nodes prohibits WSN’s from exploring its capability [1-3]. Some of the solutions proposed by researchers are in the form of modified aggregation, routing and hybrid communication scheme (Transport layer). However, from the available options modification/updations with the network layer seem to be best choice [4]. Alternatively, offering mobility to sink (base station) node in data collection can also be the best choice in hierarchical network. Nonetheless, mobile sink approach results in added internal overheads and results in added energy depletion [5-8]. By adding heterogeneity with homogeneous network will also improves the performance of sensor network (termed as Heterogeneous WSN). Here, are some of the categories of heterogeneous networks like network with varied computing power nodes, links and energy capability. This is more identical to real-life system devices. Some of the application areas of WSN or HWSNs are in weather forecasting, in agricultural for plant health monitoring, in disaster management for rescue operation with shortest route, in human health conditioning, and in industry (4.0) [9]. Data communication inside WSN mainly decides level of energy expenses inside the network and hence, energy remains in the network. Thus, suitable data communication approach, strategy of energy management and node placement approach combine considered in designing suitable energy efficient protocol. To accommodate this cluster based routing protocol is the possibly effective option as compared to others. Clustered approach enhances the energy efficiency of WSN by minimizing internal overhead, and by load balancing [9-12]. By rotating the role of nodes such as cluster member (CM) or cluster head (CH), it is possible to reduce energy consumption of the entire network [13]. Clustered based routing protocol reduces the burden of distant nodes, improves node (network) connectivity, and supports scalability [14]. Hence, cluster based routing enhances energy efficiency of the network to a multifold. This accelerates stability period and lifetime of the network to a better extent. Clustering can be classified as balanced, unequal, centralized, distributed, flat model, Hierarchical and multi-level clustering. Cluster topology consists of three elements namely as Base station (BS), CH and CM. Here, BS node, the main control element of the network that controls the entire network activity with the help of CH node mostly. CM node, node normally used for event sensing and in CH updation or sometimes in reporting to sink node as per protocol policy. Clusters head work with CM under the control of BS. Different data collection strategies are are like time driven, event driven and query driven approach [14]. In the first scheme CH node collects data periodically or on a set time for BS. Secondly data collection is based on event occurrence, like land slide, water level of dam is reached to limit [16]. Finally, data collection through CH is initiated by BS with query [17].

Moreover, clustering approach can be classified as Homogeneous and Heterogeneous WSN clustering [10]. This paper aims to reduce energy expenses of the network, optimizes the cluster size and select best possible node for the role of CH as depicted in [18]. In proposed design, cluster head (CH) selected based on initial energy, residual energy, relative distance, varied epoch and based on node reusability. This design also follows the node degree (incoming) in finalizing most prominent node for the work.
responsibility. Resultantly, proposed system significantly improves the stability, lifetime, throughput and the residual energy of the network independent of the level of heterogeneity. Here, we rotate the role of CH based on epoch period, such that load balances evenly. We maintain the record of node reusability (node completed the role of CH) and distance between the node to the sink node. This help in reducing the energy consumptions of varied energy nodes. Proposed MO clustering (MOC) protocol to prolong the lifetime of HWSN is validated through simulation with available well known protocol over 12000 cluster rounds with the sampling frequency 500. We found that proposed MOC-HWSN outperforms the published scheme by 1.97 times. Paper is organized as related work is presented in the form of Part-2. Protocol basics, Network model and Energy model is highlighted in Part-3 of this paper. Part-4 gives the details of proposed protocol and its operation. Part-5 summarizes the results and discussion of simulation. Conclusion with reference to developments study and future scope is been highlighted in Part-6.

2. RELATED WORK
Energy efficient design approach seems to be more demanded in remote event monitoring. Cluster based routing approach is the possible solution to achieve energy efficiency and to prolong the performance parameters. This improves network connectivity, network management and extends the reliability. One of the main achievements with clustered approach is improved scalability [19-21]. Cluster based routing can be classified based on node type, arrangement, and type of communication (single hop or Multihop). Clustering can also be categorizing as single, multilevel and multistage. Clustered WSN can be static or dynamic [22-24]. By reducing the energy consumption in relaying collected data, it is possible to prolong the aliveness of network. Some of the options for energy efficiency are presented in [25-29]. These approaches are based on random CH selection, residual energy, and ratio of residual to network energy or sometimes with average energy of the nodes. CH selection can be based on DFS algorithm or with subgraph connectivity. CH selection also be possible with auto-correlation, fuzzy parameters and may be based on different aspects of Particle Swarm Optimization (PSO). Clustering can be made very effective by dividing the network layout in some small subsections (zones). This makes network management very effective and reduces the internal overheads of network management is proposed by the author in [30]. Hybridization of chain structure inside cluster and spanning tree protocol between CH and sink node also balances the load evenly. Anthropology that controls the recurrent CH selection and enhances the energy efficiency of the network to a great extent is also been possible. It results in balanced clustered and modified fusion rate for communication will also enhance the energy efficiency of network as presented by author in [31]. Side by side avoiding minimum energy and small distance node from the role of CH could prolong the stability and lifetime of the network. Forming virtual circle of nodes (layers) based on residual energy and distance will improve the performance of the network as per [32].

Heterogeneity aware clustering protocol can boost the stability value of deployed network is presented author in [33]. Combining stability and energy efficient approach would completely enhance performance parameters set to a better level is innovatively presented by author in [34]. Systematic node organization in network (high energy node in distant field than to dense field), also improves the network lifetime with proposed protocol is depicted by the author in [35]. Dividing the network in small cluster based on their capability could prolong the stability to a better level is presented by the author in [36]. But, this results in inbalance in energy utilization. The approach of regional energy aware clustering by isolated nodes (REAC-IN) in WSNs can compensates the demerits of clustering process, such as internal overheads and recurrent CH selection is presented by author in [37]. On the same proposition a distributed energy efficient protocol, named as Energy-Aware Routing Protocol in Wireless Sensor Networks (EAP) is depicted in [38]. In EAP, CH selection is based on the ratio of residual energy of the candidate node to the average residual energy of nearby neighbor nodes in cluster range. This heterogeneity aware clustering protocol uses STP (Spanning tree protocol) between CH families and sink node by direct communication. As energy consumed for all to communicate inside network reduced to a greater level and thus prolong the lifetime of the network. This approach supports scalability features and improves the performance parameters of designed application.

As sensor node energy constraints limit the lifetime of node, its usage demands special handling to enhance the energy efficiency of the network. In scalable network, multi-hop approach minimizes the energy cost consumed by each individual node along the communicating path. Nevertheless, finding most suitable routing path is the challenging task. So, to resolve this issue, author presents the mechanism of well-balanced energy efficient cluster routing in [39]. Merely, communication path need to be shortest one or the low energy path (less lossy path). This shortest path finding can be possible with Dijkstra, link state and Destination Sequence Routing (DSR). Just, on the cost of internal overheads in CH selection. Most of the time clusters are formed based certain probability value; nodes are location insensitive, nodes connectivity in adjacent cluster are based on hop count and energy. On the runtime, Nodes utilized are normally upto three type nodes [18, 22, 27, 30] [35-36]. However, some of the researchers try to expand the level of heterogeneity to a fourth level. Still, implemented protocols unable to incorporate all possible attribute in CH selection. So, performance parameter set offered by published protocols are limited in terms of stability, lifetime, and energy remains in the network. Hence to resolve these issues, we present MOC-HWSN in following subsection to enhance the all possible performance parameters set [40].

3. PROTOCOL ASPECTS
3.1 Protocol basics
Main goal of proposed design is to utilized 3 and 4 level node heterogeneity and testing proposed protocol. Simultaneously to verify the improvement achieved in energy enhancement and evaluate different performance parameters. Here, we control the
energy utilization in relaying the data to sink node, also data communication load of CM tried to find the different performance parameters. To achieve this, we try to rotate the role of CH and vary the threshold value for selecting CH based on residual energy of the nodes. Rotate the role of CH and allow other node to participate as per energy based epoch period. Epoch is adjusted such that all nodes dead on the same time interval from the network. Nodes selected for CH activity is based on Node Quality Index (NQI) the set criteria of value function as explained below. This proposal follows regression based formula. Node with better value of NQI than the average NQI from the network (filtering criteria) and by satisfying the boundary condition to select best possible CH node. Proposed CH need to be checked with set boundary condition. CHs are selected such that those are not towards the network boundary. As node away from the BS node will consume more energy as compared to local nodes. In proposed protocol design, we initially divide the network in four equal zones with reference to base station (BS). Average, NQI or NI value of each individual zonal node is utilized as threshold value for filtering criteria and filtering is used to select best possible node for CH role. In proposed design NQI value of each individual is calculated by BS and high value NI node is selected termed as temporary CH. Node with better NQI value amongst the available network nodes per zones is termed as main CH or final CH. This node works as relay element on behalf of network for the support of temporary CH in data communication. In this scheme, we are not considering the nodes near the layout territory for the role of CH as far as possible.

3.2 Energy consumption model used

Data communication between two sensor nodes is presented here based on certain communicational attributes. Propagation model is divided in two classes as direct and multipath model with reference to threshold communication distance. Normally, sender node will consume more energy in transmitting collected data. This is due to the energy consumption expected at modulator, energy depletion in environment, and energy dissipation at transmitting amplifying section at antenna. Alternatively, receiver expends energy in receiver radio electronics only (that is separated by threshold distance ‘d0’ or more than that). During data communication, if distance of communication ‘d’ is less than a threshold or crossover distance (free space propagation model/direct propagation for energy consumption). On the contrary, if d >> d0 then energy expenses can be calculated based on multipath/Multipath propagation model of communication. Nearer, data communication is initiated for data packet of length L (in bits). Here, radio link features utilized are similar to [25] [41-42].

Energy model details are calculated based on various communicational attributes such as, ‘E_TX’ the energy consume in transmitting data packet. Whereas the ‘E_rx’ the energy expenses bared by receiver. The ‘E_elec’, the energy consume by radio electronics, ‘E_op’ the energy expenses of multipath model and ‘E_fp’ the energy required in free space propagation. Similarly, ‘E_DA’ the energy expenses at summer in data aggregation. Lastly, the ‘E_relay’ the energy in relaying data packet of length L.

Now, we present the calculations of different attributes used in energy model.

Calculating ‘d0’ as presented here,

\[ d_0 = \sqrt{\frac{E_{op}}{E_{sp}}} \]  

Energy at transmitter over a distance ‘d’ of packet with length ‘L’,

\[ E_{TX}(L, d) = L \cdot E_{elec} + L \cdot E_{fp} \cdot d^2 \quad \text{if } d \leq d_0 \]  
\[ E_{TX}(L, d) = L \cdot E_{elec} + L \cdot E_{mp} \cdot d^3 \quad \text{if } d > d_0 \]  

Energy calculation at the receiver is,

\[ E_{RX}(L, d) = L \cdot E_{elec} + L \cdot E_{DA} \]  

If the receiver node work as relay node (intermediate node) in data communication. Then, Energy expense can be calculated with reference to following equation for one hop communication [39]:

\[ E_{relay}(L, d) = E_{RX}(L) + E_{TX}(L, d) \]  
\[ E_{relay}(L, d) = 2 \cdot L \cdot E_{elec} + L \cdot E_{DA} + L \cdot E_{fp} \cdot d^2 \quad \text{if } d \leq d_0 \]  
\[ E_{relay}(L, d) = 2 \cdot L \cdot E_{elec} + L \cdot E_{DA} + L \cdot E_{mp} \cdot d^3 \quad \text{if } d > d_0 \]  

3.3 Network Model

Presented network model is the combination of various energy nodes of varied percentage population. Some of the assumptions are listed here for reference.

a. All nodes are distributed randomly.

b. All nodes are immobile after deployment, and all of them always have data to transmit.

c. The nodes are considered as dead when they are unable to sense.
Nodes are location unaware

Network model presented is same as given in [41-42]. This proposed model is developed based on different node population. Here we are using three and four different types of nodes namely as normal, advanced, super, and ultra-node respectively. Total number of nodes are assumed to be of value N. Advanced nodes have percentage population value a with respect to total N nodes and all those are equipped with A_e (fractional value) higher energy than normal node. Normal node the percentage population factor n_n with initial energy N_e. Higher type node, the Super nodes are used with population value of s with energy value of S_e times higher than normal node energy. Finally, ultra-node the node with percentage population factor u and having energy U_e time’s higher energy than normal node energy. Energy value for normal node is N_e with population factor n_n time’s total nodes N.

An energy detail contributed by each and every node is given as follows:

3 Type Node -Network Model:

Energy of normal node calculated as;

\[ E_{NN} = n_n \cdot N_e \cdot N; \quad n_n = (1-a- s) \]  \hspace{1cm} (10)

Energy of advanced node,

\[ E_{AN} = a \cdot (1+A_e) \cdot N_e \cdot N \] \hspace{1cm} (11)

Energy contributed by Super node,

\[ E_{SN} = s \cdot (1+S_e) \cdot N_e \cdot N \] \hspace{1cm} (12)

Thus, network model complete energy is calculated as;

\[ E_{Network} = E_{NN} + E_{AN} + E_{SN} \] \hspace{1cm} (13)

Individual node details contributed in total network energy is presented as;

\[ E_{Network} = (N_e \cdot (n_n + a (1+A_e) + s(1+S_e))) \cdot N \] \hspace{1cm} (14)

If energy increment by the factor of 2, then with three type nodes, energy available with the network is:

Energy value for three type node network is;

\[ E_{Network} = (nn \cdot N_e \cdot (1+3a+5s)) \cdot N \] \hspace{1cm} (15)

Hence, generalized equation for multilevel heterogeneity network can be presented in following equation;

\[ E_{Network} = N_e \cdot (1+2a+\ldots\ldots+(2^{m-1})t)N; m=3\ldots\ldotsx \] \hspace{1cm} (16)

Where, x is any integer value, and t is percentage population factor at that respective level.

4-Type Node-Network Model:

At this moment, we are adding extra node in the form of ultra-node in network model.

We are free to use equation 16 in this case also;

\[ E_{Network} = (nn \cdot N_e \cdot (1+3a+5s+8u)) \cdot N \] \hspace{1cm} (17)

4. PROPOSED PROTOCOL

Proposed protocol and its implementation enhance the energy efficiency of network model under test by selecting suitable node for the role of CH and by load balancing. Now, Selection of CH is based on energy consuming attributes, relative position
and reusability value. Proposed design balances load evenly inside the network and achieve better node degree to a respective head level. As a result, cluster size is controlled one than the arbitrary. Like so, finally improves the energy remain in the network by controlling the energy expense.

Mainly, energy consumed by sensor nodes in transmitting state is very high as compared to other activity. So, we try to reduce down this effort through the use of multi-hop communication with distant node. On deck, load imposed over CH is reduced by the arrangement of temporary CH on behalf of zone (based on node index value) and main CH based (on behalf of network) on greater value of node index among the available nodes. Temporary CH node from each zone forward collected data to main CH and further it will be communicated to BS. Here, if any node whose is distance of communication is greater with respect to BS, communicate the collected data to nearby node based on node index value. Otherwise, data can be directly send to BS (same strategy is used for CM in relaying data to CH or main CH).

4.1 Algorithm Explanation

In proposed work, we considered different aspects of wireless sensor node for clustering like selected relay node must consume minimum energy to communicate sensed event. On this spot, CH selected must have NQI value better than average NQI value (filtering the other nodes). Selected CH are situated off the network boundary and available for the role CH. At the start, it may possible that in few first rounds large number of nodes have better NQI value than optimum cluster head value. Hence, we force try to utilize LEACH approach for first 50-70 cluster rounds. In this place, we mainly focused on query based approach for the agricultural applications. Supporting parameters of the clustering process are calculated same as [18,40,42].

5. RESULT AND DISCUSSION

Now, we try to highlights the details of simulation parameters and performance parameters. Simulation of implemented protocol is tested and validated with the set of standard parameters. Details are presented as follows. Practical set limit for the following parameters are in between 0 to 99999. Some of the details of performance parameters utilized in validation are presented as follows;

i. Stability Period: The time period in the form of cluster round before the death of very first working or operating node from the network.

ii. Number of alive nodes per cluster round: Number of nodes withstand against the varied energy excursion of the network during operation. This count expected to be very high or deplete with very slow rate. This signifies the effective load handling characteristics of proposed protocol.

iii. Number of dead nodes per cluster round: This is the vice-versa of the earlier parameter. It affects the network survival time.

iv. Throughput: Number of data packet received at the receiver (sink node) per cluster round from the deployed sensor nodes. The measure of faithfulness of designed protocol.

v. Lifetime: The time span in terms of cluster rounds before the death of last alive nodes from the network.

vi. Energy remains in the network per cluster round: Residual energy available after each cluster round is presented by this value. This implies achievement in load balancing with the proposed protocol on deployed network.

5.1 Result Discussion

Proposed implementation is tested and validated with reference to standard simulating parameter (data set) as given in table 1. Network layout contains 200 nodes; those are randomly deployed. Network layout of 200 m X 200 m is assumed. Percentage population factor used here with a=0.1 and s=0.2 with respect to total 200 nodes in 3-level network model. On the contrary u=0.4 in 4-level network model (4-type node). Energy value is incremented 1.2 times for subsequent node types. Nodes energy order is presented as ultra, super, advanced and normal node for lower energy.

| Symbol | Parameters details | Value       |
|--------|--------------------|-------------|
| X M X | Network layout     | 200m X 200m |
| N     | Total number of nodes | 200        |
| Nc    | Initial energy of normal nodes | 0.5–1.5J  |
5.2 Validation with published protocol

We are validating the proposed implementation in different stages such as, nodes used are position aware with fixed epoch (Say Contrib1). On the contrary nodes are insensitive to position with varied epoch value (Say Contrib2). In location insensitive application we are calculating the positions of nodes with reference to receive signal strength indicator (RSSI) by the use of BS the source of high computing power and energy.

As we know Low Energy Adaptive Clustering Hierarchy protocol (LEACH) the first proposal by the author of [25]. In proposed design BS selects the CH randomly based on random number generation strategy. Now, formed cluster may be of arbitrary size, which imposed extra burden on CH and leads to early death of the node (or expel high amount of energy). Sometimes selected CH can be from the network vicinity. Therefore, load distribution among the node found to be uneven. This may result in unnecessary energy expense. However, further reduces the stability and lifetime of the network. Hence, energy remains and throughput will deplete highly. Importantly LEACH unable to explore the capabilities of heterogeneous WSN. As, LEACH treats every node as equal capability node and there is no differentiation of its capability.

Secondly, SEP the proposal of heterogeneity with the inclusion of advanced nodes in homogeneous WSN can offer better performance as compared to former LEACH as given in [33]. In this protocol CH selection is based on initial energy, but less aware of location, measured RSSI and residual energy. SEP scheme normally punishes advanced nodes in the said design. However, SEP protocol is more stable as compared to LEACH protocol, but not always. As, CH selection is not systematic, thus affects the aliveness of nodes per cluster round. Adverse effect of the said scheme is on energy remains in the network and throughput from the network. Though, Design Energy Efficient Clustering (DEEC) the proposal of network energy awareness tries to compensate for energy balancing over the network as per the illustration depicted by author of [27]. In this design epoch is varied with energy of the node. But, relative distance and data communication by CH directly to BS may consume greater energy as per transmitting data activity state of operation. Thus reduce the stability of the network, results in unbalancing the network energy. Hence, reduces lifetime. Still, it is better than SEP and far better than LEACH. Compared to our earlier explanation based on published well known protocol. Proposed MOC selects the node for the role of CH based on multiple attributes, which explores energy utilization. Here, some of the attributes also been considered such as energy available with the node, node location and also assured selected CH node is off the network boundary. Zone wise CH is free from the burden of data communication to BS. As zonal CH node transferred collected data to main CH of network for relaying data packet to BS. Hence, proposed approach in stage one is work better compared with LEACH, SEP and DEEC in terms of stability and lifetime. Subsequently, formed cluster seems to be more balanced as compared to former clustering protocol. Node reusability is check before finalizing any node in CH role, if again. In proposed design nodes are location insensitive and thus consume very less energy as compared to first stage approach. In this direction, Data communication strategy is same as earlier Contrib1. Due to this death rate of node get sluggish compared with former design. This improves the network connectivity. Proportionately, results in minimal energy excursion level. With the division of network, formed clusters are of limited size as compared to arbitrary size. These limited cluster counts over the network lifetime improves network survival time to a better level. In respect to this, finally proposed design outperforms the published protocol in terms of stability, lifetime, energy remains in the network and throughput to a better level.

Currently, we are presenting the validation plots recovered from simulation ground in fig. 1 to 4. Listed fig. shows node aliveness, dead nodes, energy remains, and throughput from the network over the cluster rounds with published protocol. Eventually, we are presenting table to show the readings collected for 10% boundary condition and for varied level of heterogeneity.

| Symbol | Parameters details          | Value |
|--------|----------------------------|-------|
| L      | Data packet length         | 4000bits |
| E_on  | Radio electronics energy   | 50 nJ/bit |
| E_sp  | Free space energy          | 10 pJ/bit/m² |
| E_mp  | Multipath energy           | 0.0013 pJ/bit/m² |
| E_ag  | Aggregation energy         | 5 nJ/bit/signal |
| d_th  | Threshold distance         | 87.87 m |
| BS    | Base station or Sink node  | (100m X 100m) |
| d_th  | Threshold distance         | 87.7 m |
Fig. 1. Alive Nodes Versus No. of Cluster Rounds of MOC protocol with published protocol.

Fig. 2. Dead Nodes Versus No. of Cluster Rounds of MOC protocol with published protocol.

Fig. 3. Energy Remain in the network Versus No. of Cluster Rounds of MOC protocol with published protocol.
Fig. 4. Throughputs of the network Versus No. of Cluster Rounds of MOC protocol with published protocol.

Readings noted from the plots are presented as follows:

Performance parameters recorded with simulation by using table 2 for three and four type nodes

| Parameters recorded over the number of cluster rounds for three level | LEACH | SEP | DEEC | Contrib1 | Contrib2 |
|-------------------------------------------------------------|-------|-----|------|----------|----------|
| Stability Period                                            | 1060  | 1406| 1787 | 1987     | 2177     |
| Lifetime                                                    | 7106  | 8840| 9090 | 9115     | 9209     |

| Parameters recorded over the number of cluster rounds for four level | LEACH | SEP | DEEC | Contrib1 | Contrib2 |
|-------------------------------------------------------------|-------|-----|------|----------|----------|
| Stability Period                                            | 1782  | 1978| 2378 | 2612     | 2781     |
| Lifetime                                                    | 8439  | 10421| 10611| 11108    | 11928    |

Above presented plots and readings are with reference to 10% network boundary and cluster forming probability is 0.1. Table 2, results are presented in more elaborative way in the form of chart as given in fig. 5 below:

Proposal of 4-level nodes test under different conditions as by varying the boundary and probability of cluster head selection. As there is no such a requirement as to select the cluster head of particular amount or necessity of network area acquired by the node and its arrangement. This statement is validated under different conditions by following the help of below shown table 3.
Table 3 shows reading collected under different implemented simulation

| Probability 0.1 | Boundary 15 | Boundary 25 | Boundary 30% |
|-----------------|-------------|-------------|--------------|
|                 | 1st | 10th | All  | 1st | 10th | All  | 1st | 10th | All  |
| Leach           | 1097 | 1766 | 7966 | 1371 | 2208 | 9957 | 1181 | 1902 | 8577 |
| DEEC            | 1660 | 2855 | 10938 | 1922 | 3056 | 12621 | 1655 | 2639 | 10871 |
| SEP             | 2831 | 2546 | 10402 | 1228 | 3182 | 13115 | 1971 | 2730 | 11236 |
| Contrib1        | 2799 | 4627 | 11522 | 3337 | 5397 | 11608 | 3118 | 5176 | 12854 |
| Contrib2        | 3046 | 5060 | 11782 | 1902 | 4631 | 11788 |

| Probability 0.2 | Boundary 15 | Boundary 25 | Boundary 30% |
|-----------------|-------------|-------------|--------------|
|                 | 1st | 10th | All  | 1st | 10th | All  | 1st | 10th | All  |
| Leach           | 1220 | 1924 | 8858 | 1921 | 3093 | 13950 | 1119 | 1801 | 8125 |
| DEEC            | 1851 | 2952 | 12163 | 2693 | 4291 | 17682 | 1568 | 2499 | 10299 |
| SEP             | 2036 | 2829 | 11607 | 1837 | 4455 | 18866 | 2595 | 10701 |
| Contrib1        | 3112 | 5034 | 12812 | 3207 | 4455 | 11167 |
| Contrib2        | 3187 | 5627 | 13102 | 8734 | 19216 |

| Probability 0.3 | Boundary 15 | Boundary 25 | Boundary 30% |
|-----------------|-------------|-------------|--------------|
|                 | 1st | 10th | All  | 1st | 10th | All  | 1st | 10th | All  |
| Leach           | 1317 | 2121 | 9567 | 1496 | 2430 | 10863 | 1214 | 1959 | 8118 |
| DEEC            | 2000 | 3198 | 13137 | 2093 | 3342 | 12770 | 1701 | 2711 | 11175 |
| SEP             | 2199 | 3055 | 12010 | 1949 | 3409 | 14388 | 2026 | 2815 | 11068 |
| Contrib1        | 3162 | 5437 | 13818 | 3645 | 5888 | 14888 | 2945 | 4799 | 12110 |
| Contrib2        | 3658 | 6077 | 14150 | 4098 | 6794 | 15821 | 3202 | 5118 | 12897 |

5.3 Summary:

Based on simulation and record from fig. 5, we found that the results with proposed design are found to be better by 71.52 and 92.21 percent with 3-level network model in terms of stability and lifetime. On the contrary with 4-level network model proposed design performs better by 78.51 and 86.50 percent better in stability and lifetime as compared to former published protocol. Thus, overall improvement achieved with proposed design is 75.02% in stability and 89.35% in lifetime.

6. CONCLUSION

Hence, with the combination of stability and energy efficiency approach enhances complete parameter set of multilevel node network. This proposed protocol achieves ease of network management and able to select best possible node for the role of CH. One important aspect of reducing transmission energy required in communicating data to sink node from CH. This proposed design achieves better load balancing and well assured cluster connectivity. Hence, proposed MOC works better for multilevel clustering approach for various dimensions of network. Overall node connectivity, load balancing, and energy efficiency of CH indirectly improves the energy remains in the network and thus, enhanced the network throughput. Other important conclusion is proposed design work far better for varied objectives such as more stabilize network, prolonged lifetime, energy conscious design and more faithful network in the form of better throughput. Finally, design protocol work under satisfactorily under different implemented conditions as per table 3.

In future, we try to design and develop proposed scheme with convex hull approach with the integration of genetic algorithm for optimizing the CH energy. Alternatively, fuzzy or Genetic algorithm scheme may found effective with this design.
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