



A Systematic Combined Approach to Prolong the Life Time of Heterogeneous Wireless Sensor Network: A review of existing techniques and an engineered better approach

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Abstract: Having seen the robust advantages of wireless sensor network applications, many research works has been done in this field to prolong the life time of the network. The objective of our research work is also to find out a novel approach to prolong the life time of WSN. Many existing works focused only on a single technique to extend the life time. But we have realized that, systematic combination of more than one technique can provide a synergetic improvement to the life time of WSN. In this paper initially we have presented reviews of existing works and later we presented our proposed "A Systematic Combine Approach". Increasing the life time of the network is based on lower energy consumption and higher degree of balanced consumption of energy. This approach uses some powerful data processing node in the dense area of sensor nodes to reduce the volume of data. Optimal location of the base station, type1 relay nodes and type 2 relay nodes are used to reduce the Euclidean distance. Finally, we have applied a newly designed protocol "Modified Energy Efficient Grouping Algorithm" (MEEGA) for balanced consumption of energy. We will implement this approach on a network simulator to compare the results with similar EEPG (Energy Efficient Grouping Protocol) and LEACH protocol to realize the more energy efficiency of our approach.

Keywords: Powerful Data Processing Node, Relay node, Modified Energy Efficient Grouping Algorithm, Systematic Combined Approach, Heterogeneous WSN.

I. INTRODUCTION

A Wireless Sensor Network (WSN) is a network comprised of numerous small independent sensor nodes or motes. They merge a broad range of information technology; hardware, software, networking, and programming methodologies [8]. Wireless Sensor Networks can be applied to a range of applications [8] monitoring of space which includes environmental and habitat monitoring, indoor climate control, surveillance etc; monitoring things for example structural monitoring, condition-based equipment maintenance etc.; and monitoring the interactions of things with each other and the surrounding space e.g., emergency response, disaster management, healthcare etc. The majority of these applications may be split into two classifications: data collection and event detection. Each mote in a wireless sensor network is a self-contained unit comprised of a power supply (generally batteries). A communication device (radio transceivers), a sensor or sensors, analog-to-digital converters (ADC), a microprocessor, and data storage [8, 9]. The motes self organize themselves, into wireless networks and data from the motes is relayed to neighboring motes until it reaches the desired destination for processing [9].

II. RELATED WORK AND PROBLEMS

A. General classification of routing protocols:

On the basis network structure, routing protocols of WSNs can be divided into three categories; Data Centric, Hierarchical and Geographic [19].

i). Data-Centric protocols: Multi-hop data-centric routing protocols are basically the first class to be introduced in WSNs. Considering a large number of nodes in sensor networks, flat algorithms employ query-based mechanisms in which the sink node only requests the desired data in order to prevent continuous data transmissions and thus save power. In this group, Sensor Protocols for Information via Negotiation (SPIN) [2], Directed Diffusion [2], Energy-Aware Routing (EAR) [19], Rumour Routing [19] and Minimum Cost Forwarding Algorithm (MCFA) [19] are some of the most famous flat algorithm paradigms.

ii). Hierarchical protocols: Different from the flat category, in hierarchical protocols that utilize a clustering scheme, nodes are assigned different roles or functionality. In fact, energy conservation can be achieved in these protocols by some aggregation and reduction of data in so-called cluster heads (CHs). In this class, Two Tier Data Dissemination [19], Low-Energy Adaptive Clustering Hierarchy (LEACH) [19][2], Threshold-Sensitive Energy-Efficient Sensor Network Protocol (TEEN) [19], Adaptive Periodic Threshold-Sensitive Energy-Efficient Sensor Network Protocol (APTEEN) [19] and Power-Efficient Gathering in Sensor Information Systems (PEGASIS) [2] are some inspiring protocols.

iii). Location-Based protocols: The possibility to apply position information in routing schemes will be used in location-based algorithms to route data towards desired position in the sensor field. This can save energy by limiting the flooding through the network. GPSR, GAF and GEAR fall in this class [19].

B. Taxonomy of life time improvement mechanism:

Lifetime improvement mechanisms in routing protocols for WSNs are basically divided into two main categories: simultaneous schemes and cross-layer schemes. Simultaneous schemes [19] usually refer to the mechanisms which could be combined with routing algorithms in order to achieve a specific goal like energy-efficiency. In WSNs, these mechanisms are classified based on the protocol operation. However, cross-layer schemes investigate different layers simultaneously to make the protocol more energy-efficient. Many energy-efficient mechanisms categories such as *multi-sink*, *mobile sink*, *multi-path*, *bio-inspired* and *power control* (as a cross-layer approach) technique [19]. One thing has been observed that many of the algorithms only focuses on only life time improvement mechanism for prolonging the life time.

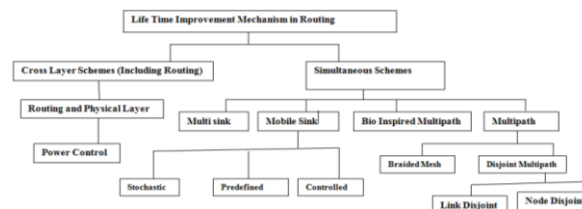


Fig.1 Classification of lifetime improvement mechanisms [19]

C. Protocols use more than one mechanism:

The table listed some protocols and their metrics, those proposed and simulated by many scholar showed that, it can gives more prominent result than using single technique.

Protocol /Reference	Mechanism	Metrics of Different Protocols						
		Sink movement	Sink Speed/ Mobility	Location Awareness	Number of Sink	Network Structure	Data Aggregation	Application Type
MSDD [23]	Multi sink, Multi path	N/A	N/A	No	K(R<2)	Flat	Yes	Query Driven
MSLBR [24]	Multi sink, Multi path	N/A	N/A	No	K(R<2)	Flat	No	Time Driven
SMPPD[25]	Multi sink, Mobile Sink	Random	Constant	Yes, Only Sink	K(≥1)	Flat	No	Time Driven
[26]	Multi sink, Mobile Sink	Fixed,		Yes,	K(≥1)	Flat	No	Time Driven
[27]	Multi sink, Mobile Sink	Controlled and Random		Yes, Only Sink	K(≥1)	Flat	No	Time Driven
MSRP [28]	Mobile Sink and Power Controlled	Controlled	Adaptive	Yes, Only Sink	1	Hierarchical	Yes	Not Specified

Protocol /Reference	Mechanism	Metrics of Different Protocols						Power Adjustment Technique.
		Location Awareness	Node or Link disjoint	Network Structure	Number of path	Network Connectivity	Application Type	
MSMRP [17]	Multi Path and Power Control	No	Node Disjoint	Flat	2	No	Not Specified	Feedback-Based (RSSI/Margin Field)
EECA [18]	Power Control & Multi-path	Yes	Link disjoint	Geographic	N	dynamic	Event-driven	Feedback-Based (RSSI/Margin Field)
[19]	Bio inspired, Multipath	No	N/A	N/A	Multi / Shortest path	Dynamic	Event-driven	Controlling traffic in Network layer

Table 1, 2: Showing the protocols, this combined many mechanisms and their metrics.

Multi-Sink Directed Diffusion (MSDD) has been introduced to forward data toward the nearest sink. Also this protocol implements a kind of load-balancing by selecting the next nearest sink after the energy level of nodes in the original path falls below a certain threshold. Simulation results show that, using MSDD protocol, connection lifetime between source and sink nodes will be increased up to three times, which is the result of reducing routing overhead of Directed Diffusion protocol.[5]. Four characteristic mobility patterns for the sink along with different data collection strategies. It demonstrates that by taking advantage of the sink's mobility, we can significantly reduce the energy spent in relaying traffic and thus greatly extend the lifetime of the network. [25]. In MSRP, mobile sink moves in the clustered WSN to collect sensed data from the CHs within its vicinity. During data gathering mobile sink also maintains information about the residual energy of the CHs. Mobile sink based on the residual energy of CHs move to the CHs having higher energy. Consequently, the hotspot problem is minimized as the immediate neighbor of the sink is high energy node and it changes because of regular sink movement.

D. Systematic presentation of some problem and positive scope of existing technique for engineered a new combined approach:

i). Limited Transmission Range: Sensor nodes are placed in some particular location of the area of attention. As sensor nodes have limited transmission range, only placed sensor nodes may not be sufficient to construct network to send their data to Base Stations.

ii). Density of node distribution: Many research articles consider that sensor nodes are equally distributed for the convenient of simulation [12]. But practically we will have hardly equally distributed sensor network. So, it will be very better to consider the unequal distribution of sensor nodes.

iii). Location of the Base Station: As the energy consumption is linear function of distance travel by any data packet. So, definitely the location of the base station has a great impact on the energy consumption. [14]. So, here the problem is to find out the best suitable location of the Base Station. It is a NP problem. So it is very critical to find out best single appropriate solution.

iv). Homogeneous and Heterogeneous Sensor Network: Many of previous algorithms considered the WSN as homogeneous [13]. But, in practical scenario WSN consist of many heterogeneous nodes. So all the algorithm made for homogenous may not work efficiently in all practical scenario so, here is a need of some robust algorithm, which can work more energy efficiently without compromising the performance. Many algorithms those are developed for homogenous WSN and also some, those developed for heterogeneous WSN does not take in to accounts the different bandwidth of Link between different nodes. If we consider it, then it will be more practical.

v). Techniques for Reduce the distance and volume of data: To reduce the volume of data and distance many algorithm has been developed. Among those, some algorithm consider clustered network. The entire node connecting to the clustered head will send their data to the clustered head to reduce their travelling distance and to reduce their volume of data. Very famous algorithm known as LEACH also comes under this category. In this algorithm acting as role of cluster head have need more energy consumption. To reduce this problem although LEACH algorithm changes the role of Cluster head within the cluster among the node after some round based on residual energy. Although clustered network architecture have more advantages as compared to flat network architecture in distance parameter, even none exiting single algorithm can reduce the distance and volume of data simultaneously and these require more computational process and reducing of volume of is not satisfactory.

vi). Hotspot problem: To tackle out the hotspot problem occurs in the nodes, those are nearby base station, many algorithms has been developed but none single algorithm showed satisfactory result. One of algorithm comes which considered the use of mobile sink [3]. According to this algorithm the sink will fly from one location to another predefined or random location and during fly, it will not communicate with any node. But, the idea of flying is not practical, because in some critical application area, flying of Sink above the forbidden region may be visible to the enemies. As it will not communicate during the flying, it can't give response to any event occurs immediately. So for real time system this idea will not practical. Another algorithm Fuzzy Clustering Algorithm (FCA) is approach to overcome the hotspot problem occurred in LEACH protocol [15]. FCA adjusts the cluster-head radius considering the residual energy and the distance to the base station parameters of the sensor nodes. This helps decreasing the intra-cluster work of the sensor nodes which are closer to the base station or have lower battery level. To solve this problem we can use multiple sink. But again the problem is to determine the suitable location of the respective location of the sink. Although it has provides a little improvement in energy efficiency, but it is again a costly mechanism.

vii). One hope vs. multi hops communication within a Cluster: In all the clustering algorithm one very important issues is to taken whether Single Hop Communication and Multi hope communication. The LEACH protocol and many of the variants LEACH Protocol considered on hope communication by the data of node to reach the clustered head. In "Homogeneous vs. Heterogeneous Clustered Sensor Network: A Comparative Study" [22], have explored that multi hope communication is more energy efficient and also in the term of hardware cost. In [22] the author at first compared the single hope homogeneous LEACH with the variant M-LEACH (Multi hop), where he found that M- LEACH is better than original LEACH. Finally M-LEACH (homogeneous) is also compared with the heterogeneous M-LEACH. Here the author found that in maximum case heterogeneous M-LEACH outperforms than original LEACH and also homogeneous M-LEACH. So in our proposed approach, we can take into account this feature to add outperformance.

viii). Biologically inspired algorithm: Many biologically inspired algorithms have developed to solve various real life problems. Similarly ANT Algorithm, Ant Optimization Algorithm and Improved Algorithm, Jumping Ant Algorithm have been proposed for the WSN to find out best shortest path, to balance the traffic overhead of the shortest path providing less traffic alternative path and to easily tackle out the failure of nodes automatically,

and to capture the dynamic changing topology.[20][21]Although these algorithms have many advantages, but one disadvantage is that a large amount time is consumed to find out the shortest path, during that many packet will travel at random via many long rout, as a result the energy will be high. So we have a new idea to solve this problem. To tackle out the failure of node and to reduce the problem of heavy traffic in shortest path, one idea is to keep option of different address of different adjacency nodes those within the range of sensor nodes in the routing table of each node.

x). **Optimum number and location of Relay node:** Since, energy consumption $E_c \propto E_d$ (Euclidean distance), So many algorithm have designed to reduce distance to be travel by data with different approach approaches. One algorithm come optimal placement of relay node [17] [18] to reduce distance travel by the data. Another algorithm argues that adding more than an optimum number relay has no effect on energy saving [6]. So it is very important to consider the number and the location of relay node to construct an energy efficient sensor network structure.

xi). **Active mode and sleep mode:** Many existing work explored that, during idle time if a node goes to the sleep node goes to the sleep mode, it will dramatically save the energy [16]. But it will be always not true for application. Because those application demand continuous data collection in a continuous rate, active and sleep concept will give negative result. It will give positive result in those application, where event detection more desirable. But, if the frequency of Active –Sleep Transition is high, then also may show negative result

III. PROPOSED APPROACH

To extend the life time of sensor network, we have reviewed the many existing work. Some those have less viability to practical environment, some mechanism are costly to implement, some of them greatly compromise with the performance of WSN and some of them are very complex in computation. Similarly we have found some technique those have great contribution to prolonging the life time. But still remains chances to more improvement in the extension of life time. For these purpose we have proposed an approach which take advantage of some existing work. Our proposed approach is “Systematic Combined Approach (SCA)” which combines many existing idea with our own idea. *This Combined Approaches means* “Use of Powerful Data Processing Node in highly dense area of Sensor Nodes applying “Scanning of Square Partion Algorithm (SSPA)”, and taken into account the optimal location of the Base Station applying the algorithm Minimum Average Distance of Base Station (MADBS) from all pdp nodes, and use of Type 1 Relay node applying SMTAS(Steiner Minimum Tree Algorithm for Sensor Nodes) algorithm to construct Steiner Minimum Tree to ensure no node is in isolation and every senor node will transmit data to adjacent node through shortest distance, Type 2 Relay nodes are used to ensure that any remote pdp node will transmit data to base station only via pdp node or type2 relay node, and use of Modified Energy Efficient Grouping Algorithm(MEEGA) for) for balanced consumption of energy.”This protocol constructs a hierarchical clustered network based on the average of initial energy with respect to each group. In this approach we proposed a new idea include a special type of node in the cluster for many data processing tasks to reduce the volume of data, to reduce the frequency of changing cluster head

A. Objectives:

Main objective our research work is to prolong the life time of the network. To achieve this objective we have considered the following other important objectives.

- 1). To reduce rate of total energy consumption after each round.
- 2). To increase the stability of the network
- 3). To increase the life time of critical nodes
- 4). To increase the degree of balance energy consumption.
- 5). To decrease the number of alive nodes just after going the network obsolete
- 6). To increase throughput

B. Energy Consumption and Objective function:

Energy Consumption by a node E_c is the function of Volume of data to be processed (V_{data}), Numbers of Operation to be performed before send data to the others node (N_{op}), Euclidean distance between the two nodes (E_d) and Energy loss due to the thermal agitation of electrons (E_{loss}). If $\uparrow$ denote the desirable value is high and $\downarrow$ denotes the desirable value is low,

Energy Consumption Function, $E_c \downarrow = E_d \downarrow \text{ and } V_{data} \downarrow, \text{ and } N_{op} \downarrow, \text{ and } E_{loss} \downarrow$ ----- (i)

So, increasing of the life time of network is based on mainly two things a).The Energy Consumption Function E_c should as low as possible and b).Should has a high degree of Balance Energy Consumption [(d (BEC))].

So, Life Time Increasing function (LTIF) as follows, $Lifetime (WSN) \uparrow : E_c \downarrow \text{ and } d (BEC) \uparrow$ (ii)

So, the *objective function* for increasing the life time of the network is to have lower value of E_c and high value of d (BEC). The LTIF also can be called as objective function. So, from the above Energy Consumption function and objective function we will have to understand that, any approaches we apply for the increasing of the life time of network should have capability to decreases the Euclidean distance between two nodes ($E_d \downarrow$), Reduce the volume of data to transmit from source to base station ($V_{data} \downarrow$), and Reduce the number of operation to be perform for aggregation, conversion, and compressing ($N_{op} \downarrow$) Provides high degree of Balance Energy Consumption (d (BEC) $\uparrow$). Energy loss is depending on quality of used radio equipment, so it is underlying area of Physical Layer. To reduce the Energy loss we will have use technically sound radio equipment.

C. Parameters to be used for Measurement:

- 1). Total Residual Energy with respect to each round
- 2). Number of live nodes with respect to each round.
- 3). Average residual energy with respect to numbers of live nodes.
- 4). Average of deviation of energy consumption form the mean/ mode value.
- 5). Round number at which all the critical nodes dies.
- 6). Throughput
- 7). Packet Drop Ratio

D. Assumptions:

- 1). Different type of node has different energy level, different computation and processing power and also different range.
- 2). Network architecture is hierarchical instead of flat.
- 3). Transmission range is different of different types of nodes.
- 4). All the sensor nodes are uniform but unequally distributed through the network.
- 5). Data processing operation can be Aggregation, Sensory Fusion, Encryption, Conversion and Compression etc.
- 6). We have consider heterogeneous network as heterogeneity is more energy efficient than homogeneous [13]
- 7). Active and Sleeping modes of various nodes is application specific to provide energy efficiency [16]

III. METHODOLOGY

The methodology provides a systematic of our proposed approach in step by step, such that we can engineer it, as a better approach to prolong the time of wireless Sensor Network. The Figure 4 showed it in an abstract form,

Step 1: Sensors Nodes Distribution:

Sensor nodes are unequally distributed in the area of attention. Some sensor nodes are may be in isolation. Type 1 relay nodes are use to solve this problem in step 4

Step 2: Introduce of Powerful data processing node:

Powerful data processing node are used in some highly dense sensor area to reduce processing task of each sensor node before forward to the Base Station via Multi hop network.

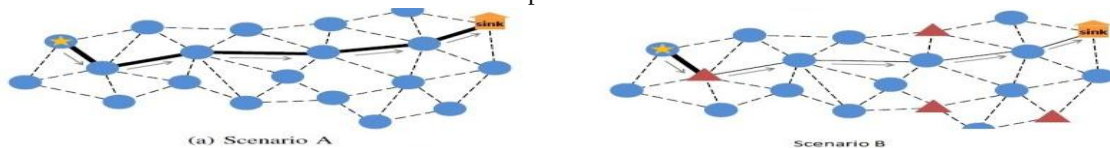


Fig 2: It shows benefits of using PDP node in Sensor Network [1]

In the fig 3, scenario A, without a PDP node, the network has to carry high volume data in contrast to the scenario B. Now the problem is that how can we can know where we will have to Place the PDP node, what is the condition? We have proposed one idea that the whole area is to divide into equal square partion and find out the total number of nodes in that square partion. If total number of node is more than or equal to fixed (pre decided number) than place a PDP node in the centre of that square partion or in a best location within that partion. The number of required PDP node and about their co –ordinates should be taken as before the deployment of the network, as shown in fig 4.

Step 3: Finding the suitable location for the Base Station: To find out a suitable location of base station we proposed an algorithm as “Minimum Average Distance from Base Station” (MADBS). This algorithm will calculate average of total Euclidean distance for many alternatives location of Base Station. And finally decide that location, for which location algorithm return the minimum average distance of base station from all PDP nodes.

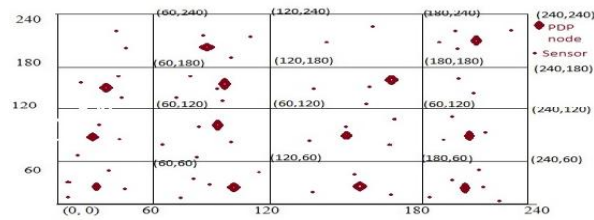


Fig 3: 240*240 square meter areas into 16 partition of 60*60 square meters to find out the number of sensor node in each partition

Step 4: Use Type 1 Relay node: Type 1 Relay node are used to construct a transmission structure applying Steiner Minimum Tree Algorithm which will require minimum number to ensure that no is in isolation and every sensor node transmit data to short distance adjacent node. This idea of SMT was first proposed by Jakob Steiner for Combinatorial optimization Problems [5]. Ying Zhu and Qi Han also mention about construction of Steiner Minimum Tree to have optimum number of relay [6]. The type one relay node some less powerful then Type 2. It transmission range is equal to the sensor node. In this example we have keep one PDP node within one partition if total number of sensor node is more than 4.

Step 5: Types 2 Relay nodes: Type 2 relay node is used to have optimal shortest path from all pdp nodes to base station and to ensure that any remote pdp node transmit data only via other pdp node or type2 relay node. We do it by applying with the Steiner Minimum Tree Algorithm on pdp nodes. The transmission range of Type 2 relay nodes is equal to the transmission range of PDP node.

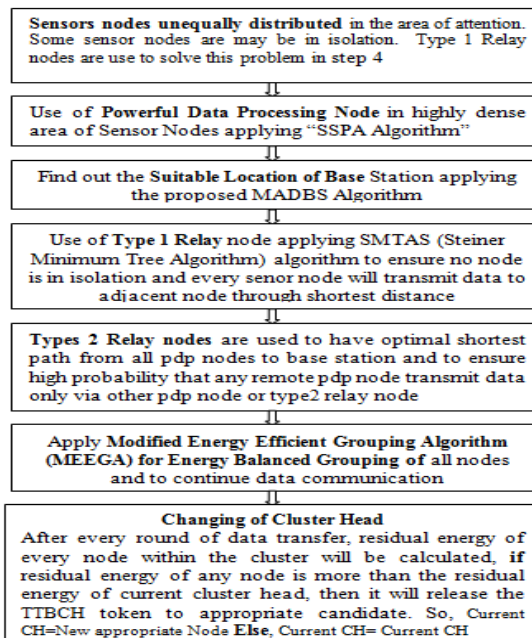


Fig 4: Shows flow of all steps of Systematic Combined Approach

Step 6: Modified Energy Efficient Grouping Algorithm: Modified Energy Efficient Grouping Algorithm for Balanced Energy Consumption: After completion of the Step 5, we will have all the nodes to construct a full-fledged Network, i.e. the total number of node and their coordinates, but not the confirmed and complete adjacency list of all nodes i.e. which node will communicate to which node at the time of actual communication and how will be running. To handle this situation we have designed a new protocol, known as MEEGA. (Modified Energy Efficient Grouping Algorithm) modifying the existing Balanced Energy Efficient Grouping Protocol (BEEGP) [7]. As we have found that cluster network is more Energy Efficient than flat Architecture. This algorithm also constructs a hierarchical cluster network dynamically. In this algorithm the base station calculate the total energy of the network form the initial energy of all nodes. And it will find out the average energy of the Group dividing total energy by desired number of Group. It will also consist of Grouping Phase and Data Transmission Phase. Data Transmission Phase again consists of Cluster set up phase and Steady state phase.

Step 6.1: Grouping Stage: Suppose the number of PDP is node pdn, so we also assume to have the number of cluster is equal to the number of cluster k, total initial energy is TIE. Now average initial energy is calculated as $AIE = TIE / k$, and total numbers of nodes in one group $tn_g = tn / k$. Where tn (total numbers of node any current

time) is total numbers nodes in the network. The Base Station will send the GH Message to the entire PDP node one by one. When the base station will send the GH message to the first PDP node, it will become the first Group Header and collect its group member by broadcasting the GMR (Group Member Request) message. After completion of the collection group member the first Group Header will send the MCC (Member Collection Completed) Message to Base Station, such that Base Station can send GH message to the next PDP node to make it group header. The GH message consist of global id of that PDP node, Group Head Number (ghn), Group Number (gn) and Average Initial Energy (AIE). Similarly GMR message consist of Group Head Number (ghn), Group Number (gn), id of all nodes as destination except the id of PDP nodes. When any Group Head broad cast a GMR message it is received by all nodes except all the PDP nodes. If, that nodes does not already belongs to any group it send an acknowledge message (ACK) showing the willingness to join the group. The acknowledge message consist of id of that of nodes value of initial energy .On receiving the acknowledge message from each node, GH_i accumulate the initial energy of each nodes in the sequence according to the order of reception When the sum of the accumulated energy (tteg –total temporary energy of a group) is equal to or bigger than the group average energy (or Average Initial Energy -AIE), GH_i will send MCC message to the Base Station and the nodes with the accumulate energy are set to be the group members.

As the Base Station receives the MCC message, it will increment the value of gn and ghn by 1, and send the GH message to next PDP node. In this way the base will send the LGH (Last Group Head Message) to the last PDP nodes. When the Base Station will receive the MCC message from the last Group Header, it will start Data Transmission Stage. One thing we have not cleared here, that the nodes those does not within the direct communication range of any Group head, how they will get GMR message to join a member of any group. One solution is to allow multi hop communication, such that every node will also transmit the GMR message to it all adjacency nodes (i.e. to all the nodes those within the range, except the incoming node). Similarly if a node does not belong to any Group, it will send the ACK message to Group Header through the same path, by which path it got the GMR message. That means any nwdr-GH node (node not within direct range of any Group Head) follows the forward communication (to send Ack) in address centric manner. When the GMR message is received by any nwdr-GH node, it updates the routing table for forward path to send ACK message. . The rule of the back ward communication is that, at time sending any message to any adjacent node it adds the id of own in the address field of message, no matter whether the message is its own message or received from any other nodes. So it is cleared that first GMR received by any node (in the backward communication) will update the routing table of it, such it can fix the path (for forward communication) to send the acknowledgement message.

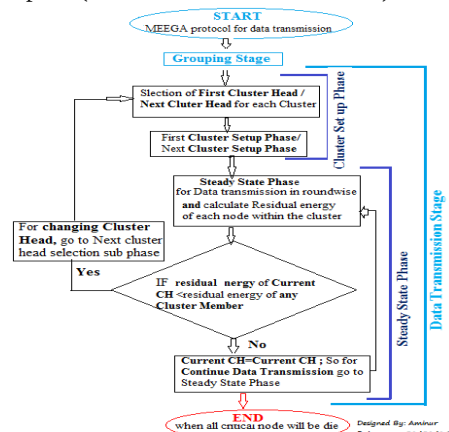


Fig 5: Shows the Stage and Phases of MEEGA protocol

Step: 6.2: Data Transmission Stage: This stage is consist Cluster Set up phase and Steady State Phase. As the Base station has received MCC message from Last Group Header, It will start data transmission.

Step: 6.2.1: Cluster Setup Phase: The main objective of the cluster setup phase is to select all the Cluster Head and to make Clusters for each cluster head. At beginning all the nodes wait to become cluster head. The waiting time is the reciprocal to the nodes residual energy. That means the nodes with the higher residual energy will wait for shorter time interval. In a group the node with maximum residual energy will become the cluster head and it will broadcast the DEC message to construct the cluster for it, while other node of that group abort their attempt to become cluster head. In this way every group will elect a node having maximum residual energy in the group to be cluster head. This message includes its node id and Group id. Now every Cluster Head will broadcast a DEC message to all nodes throughout the network .All the Cluster head will abort the DEC message which it send itself. When all the cluster head will send the DEC message, every node will receive k number of DEC message. Now the problem is to which cluster head a node should join? A node will send the Join Request (JR) to that cluster head form which, it has got the strongest signal strength. If signal of all the strength of all DEC signal is

same, then a node will send JR message to that cluster head, from which it got the DEC message at first. That means a node join to the very closer cluster head. The above rule of this protocol compel to a node to select Same rule will followed by clustering phase for nwdr-CH node(not within the direct range of cluster head) as followed in the grouping phase for nwdr –GH node. cluster head of that group and also the group header will select as a cluster header for long time as it will have high residual energy Only difference is that decision of changing routing table is not taken immediately as the DEC message received (in the back ward communication). It will wait for predefined duration of time slot to check that any more DEC message may be received from another adjacent node. If more than two or more than DEC message received by a node, than only that DEC message can change the routing table of the node, which have has the highest signal strength. After fixing the path by DEC message in the routing table, the node will send the Joint Request Message (for forward communication) to clustered Head. That means clustering phase also follow the address Centering Communication.

6.2.2: Steady State phase: In the steady state phase actual data transfer will running for the fix time slot .Every node transmit data through that path, which is fixed in clustering phase by DEC message in the routing table of that node. Here any mode of communication can be followed for data transfer; either may be address Centric or Data Centric. But each of them has some advantage and disadvantages. In address centric mode, data fusion is not done by any intermeditory or by non-leaf node; it will only relay the data to any other upward adjacent node or directly to clustered head. Similarly every Clustered Head have constructed a routing table during the clustered set up phase and stored in its memory for the forward communication to transmit the data to the Base Station.

i).Function of PDP node or Clustered Head in Steady State: Every P DP node or clustered head will do this task before forwarding next clustered head or any intermeditory nodes or to the Base Station. Here we will use an efficient data compression and decompression technique. Here also mode communication (address centric or data centric) will be dependent on the type of the application. Various functions are Data aggregation and Sensory Data Fusion Data Compression [1] [31] [32] [33]. Now, data transmission will be occurring in round wise. After each round,

- a) Residual energy of each node and also residual energy of clustered head will be calculated.
- b) Total Residual Energy will be calculated by Base Station using the following equation.

$$TRE = \sum_{sn=1}^{MaxSn} RE[sn] + \sum_{n=0}^{n=pdn} RE[n] + \sum_{rn=0}^{rn=trn1} RE[rn] + \sum_{rn=0}^{rn=trn2} RE[rn] \text{----- (iii)}$$

- c) Base station will calculate the number of total live nodes with the help of clustered head and also the stability period.
- d) Energy consumption by each node =Initial Energy minus residual Energy. $Ec[i] = IE[i] - RE[i]$ -----
-(iv)

We can calculate average of total deviation from mean or mode to check the degree of balance communication.

ii).Conditional Alternative path communication (CAPC): It is a featured rules in our MEEGA protocol we added to avoid network portioning. When any upper level node has failed, all the adjacent nodes of it, those considered in the primary rout contribution, will be unable transfer data. To solve this problem we have added one attribute in the routing table of every node, beside of store primary path, it will store a secondary path in the routing table of every node. When a node of the primary path fail during period a round, the node will make the secondary path as primary and it will also search for another secondary path as reserve, if available. We don't use concept of normal multipath communication for load balancing, because our clustering approach is good approach and the duration of round is optimum period of time, rate of data transfer is optimum. So, heavy hope heavy burden data will be not arising during the short period of time.

Step 6.3: Cluster Head Changing (Next Cluster Set Up)

In this way data have been transmitted in round wise. After each round every cluster head will compare its residual energy with the residual energy of its members. When the residual energy of any member will be more than the current cluster head, then the current clustered head will be ready to release TT BCH (Token to Become Clustered Head) token to transfer the role of cluster head to other member. Current Clustered Head will compare the residual energy of each member one by one, cluster head will release TT BCH token to that member which have highest residual energy. In this way a new cluster head will fix and it will collect the cluster member by multicasting DEC message only to the nodes within the clustered head instead of broadcasting to the all nodes. After a number of rounds some critical node will be start to die. So we will have to keep track of round of starting critical nodes dies and complete of all critical node dies. We will also calculate the throughput and packet drop ration to compare the performance of our Systematic Combined Approach. Now we have the

complete hybrid 2 tier model of the sensor network. Base Station, Relay-PDP node tier and Sensor –Relay tier. In the above figure CN represent the critical node. It is very important to identify the critical node, because one of our objectives is increase the life time critical node for longer life of the whole network.

Need for modification of BEEGP for MEEGA: If we directly apply same grouping stage of EEGP without modifying it, some group may include more than one PDP node or some groups may not include a single PDP node, which is not desirable for our approach. Of MEEGA protocol

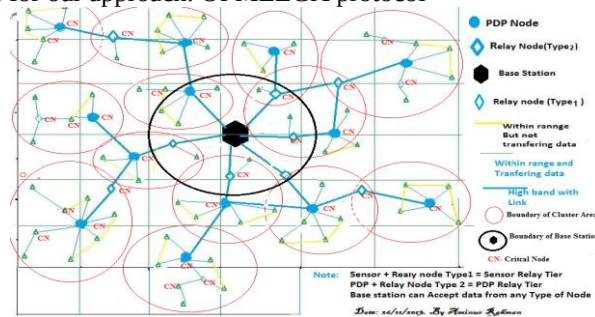


Fig 6: Shows Structured of Network, engineered by SCA.

V. DISCUSSION AND CONCLUSION

Many problems associated with the extending of life time network like network partitioning, hotspot problem etc. are taken into account by many previous combined approaches. Although these energy-efficient mechanisms look promising, there are still many challenges that need to be resolved in order to improve sensor network lifetime. For example mobile sink approach have new challenge obstacle detection and forbidden region. Multiple sink approach has suffered so much in control overhead. Similarly, power control schemes need high execution cost due to calculating the RSSI/LQI parameters. Giving more importance only to network life most of the also does not consider the many important parameters delay, throughput and security. Some of the challenges we have cover up in the SCA approach and rest of the challenges are keep for future research.

The objective function to prolong the life time is, to reduce the energy consumption, and to have higher degree of balanced consumption of energy. The section ‘methodology’ of this approach clearly explores that SCA includes a numbers of techniques for reduce the energy consumption by reducing the, volume of data to be travel and also includes a prominent technique MEEGA for balance energy consumption. Our SCA approach is Multi hop, Data Centric, Address Centric, Conditional Multi Path Communication Protocol in Hierarchical Clustered Heterogeneous Sensor Network. From the logical and systematic combination of this approach we have a great hope that it can give better performance in the terms of energy efficiency and the strategy of combining many simultaneous techniques will bring new revolution towards WSN.

VI. FUTURE WORK

We will implement our approach in NS 2 and compare the result with similar algorithm LEACH and BEEGP to realize the better Energy efficiency of it and also the technical viability. In future work we will also take into account the positive impact of optimum transmission of sensor nodes, relay node and base station. We will also analyze the viability concept of taking multiple base stations into this approach. SCA approach is basically engineered for those application, which demand continuous data collection. In future we adapt it for event detection and we apply the concept active and sleep mode of node for more energy saving.

ACKNOWLEDGEMENT

This work has been supported by Department of Computer Engineering; Punjabi University Guru Kashi Campus, Punjab. For this, we are very thankful to Sardar. Balwinder Singh, Head of the Department, for his valuable inspiration and suggestion

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