LAB Scheduling Based Dynamic Multi-Hop Routing & Clustering Algorithm for Efficient Performance of WSN Parameters

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Abstract:
The energy usage constraint is the most critical and desired parameter in wireless sensor networks, and it is the subject of a lot of investigation. With the same motive, survey efforts have been made here, and it is focused on strategies that have been incorporated to increase energy sustainability. Apart from the above, this approach is been evaluated using Cross Layer Network for better output. The results when compared to cross layer network model outperforms good when as compared to the individual layer performance. The routers that are active in WSNs serve an significant role in terms of their position, velocity, and which cluster they are connected to. All nodes may not have the mobility to move from one place to another, for which the MEP algorithm has taken place in this research so as to identify the mobile nodes so that it has to be used for proper communication purpose in comparison with the existing models such as EQSR and ED. Each node-node distance has been evaluated for proper monitoring of the mobile nodes. Only certain nodes with adequate residual energy within themselves can generate the beaconing signal, allowing for precise propagation with minimal energy consumption. Considering the nodes which are having the mobility, the energy consumption can be reduced. It can often be reduced by only taking nodes into account with the appropriate residual energy inside the network. The states of the nodes, like Active, Sleep, Idle, as well as Dead, are also essential for interaction and must be regularly assessed in order to ensure a high PDR value. In contrast to existing protocols such as SMRC and LEACH, effective multi-hop networking is developed depending on DMRC protocol to control each and every node under either of the clusters inside the cluster head. RWS method has also taken into consideration for proper choosing of the routing path along with its estimation. Also, proper scheduling is need to assign the selected nodes for transmission for which LAB scheduling algorithm is implemented in comparison with the existing scheduling algorithms such as BOP and MeshMAC to achieve optimum system throughput. The complete work is been carried out using the NS-II simulation software.

Keywords: MEP Algorithm, DMRC Algorithm, Load Adaptive Beaconing Scheduling (LABS), Energy Consumption, Residual Energy, Packet to Delivery Ratio, System Throughput.

1. Introduction

Energy supervision plays a significant part due to the resource restrictions on WSNs. Resource limitation is addressed preferring the variety of hardware elements, levels of the Open System Interconnection stack, batteries, radio and routing protocols. Here data broadcasting is one of the key features of power & energy consumption. Henceforth, the broadcasting between the base station (BS) & additional components must be more competent. However, due to recent advancements in convenient equipment's, it is feasible to have a dominant base station although still restoring the mobility feature of the network environment (Avijit Mathur, et. al., 2014).

Throughput is preferably determined in (bit/s or bps). It is termed as the addition of the data rates that are distributed to all terminals in a network. With respect to the above concept preferred in regards to broadcasting environment, likewise as internet or else packet radio services & system throughput which is the rate of successfully information delivered over broadcasting medium. The information's might be distributed over the physical link or it can transfer to a node through a certain network. The throughput of a broadcasting channel might have the impact on related factors, involving the restrictions of analog physical medium, accessible processing power of the system device & the behaviour of the end-user. When different protocol overheads are considered, constructive rate of the transmitted data could be gradually less than the maximum retrieved system throughput; the beneficial part is regularly called as efficient system throughput (Mohamed Baseri, et al; 2014).

Prediction based approach efforts to optimize the amount of energy spent for communication purpose on constructing the energy map by knowing the remaining energy and also the future utilization of energy of transceiver nodes. In this model, the distance has been calculated using the Euclidian method and a threshold has been decided. If at all the node has the mobility, then it starts moving from its origin place to a different locality inside the network environment. If the distance between the origin location and the new location to which it has reached is superior to the value of the threshold, after which the node starts beaconing itself to shares its information to the neighbouring nodes else it doesn't beacon. Like this, the residual energy of each node has been identified so that proper communication can be chosen depending upon the available data of the residual energy of the nodes through which less energy usage can be obtained (M. K. Mohiddin, et al; 2020).

Clustering Head (CH) election algorithm is preferred to recognize the appropriate clusters to check whether they exist inside the same network environment or in different network. Also, Dynamic Multi-Hop Routing & Clustering (DMRC) technique is been introduced through which the node itself can recognize to which cluster it corresponds to base depending about how far apart between the clusters adjacent the node relevant to the residual energy to obtain efficient values of packet to delivery ratio.

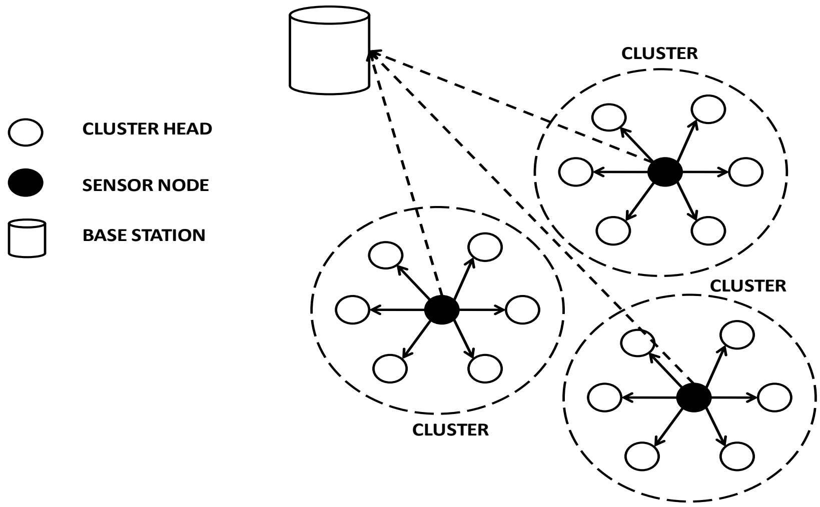

Figure 1 *Cluster Head Election*

The method of RWS (Roulette Wheel Selection) has been introduced to select and fix the routing passageway that can be preferred for broadcasting in least amount time duration along with the nodes which having the high residual energy. LAB scheduling approach has been included for appropriate monitoring of each node during different mode scenario likewise active, sleep, idle and dead situations. Due to the mentioned two approaches, the proper transmissions will be done; therefore an optimized value of system throughput is obtained (Md. Khaja M., et al; 2019).

2. Literature Survey

In WSNs, it have been clearly observed that X-layer operation model is been usually preferred to estimate the consumption of energy depending on the energy level compared with respect to sending & reception modes including idle & sleep mode. The evaluation of consumption of energy of the proposed model using cross layer is done by comparing it with EQSR (Energy Efficient & QoS Aware Multipath Routing) protocol as well with standard model of IEEE 802.15.4. An EQSR have to be specifically suggested for WSNs based on QoS approach. The protocol implements various multi-path routes to estimate the effective route from source to sink. The approach has the functionality to cross layer its routing link preference option based upon the PHY layer components of the NXTHN. The elements might be the node’s remaining energy, signal to noise ratio & interface buffer availability existing between two of the neighbor nodes (Marwan Al-Jemeli, et al., 2015).

MANETs is a promising technology, less interior with self-managing, self-restoring, multi-hop real-time wireless routing networks as shown in Figure 1. In this category of networks, many of the problems is on the basis of routing produce due to the complications in the mobility of the environment which leads to the convolution in obtaining energy efficient routing. Due to the restricted energy of the battery & dynamic nature of the nodes having mobility, the communication path among the intermediate relay nodes may break regularly, therefore having the negative effect on the evaluation of the routing within the network & as well the presence of the nodes. In spite of prevailing protocols are not focusing on the communication path & battery energy, node path is the essential factor in enhancing the quality of the routing protocols as the rank of the node assists us to evaluate whether the nodes are within the range of transmission or not through the remaining energy available with the node throughout the process of the routing. A unique Energy Efficient Node Rank-based Routing (EENRR) method is proposed which has the performance metric of few parameters like residual energy, packet overhead in order to boost the execution of the PDR & lifespan of the network in comparison with the conventional protocols (D. Kothandaraman, et al., 2019).

In this research, it has been reviewed many schemes of mobile sink node movements likewise fixed, random & predictable managed with less & high mobility in order to enhance the QoS, end-to-end delay, network lifespan & average normalized load available adjacent to the destination node which is fixed along with the average count of hops. It is also observed that the improvement in the QoS can be obtained by considering the monitored octagonal trajectory, where the destination node travels along the octagonal perimeter; also it has been observed that average system throughput has been optimized when the destination node is having some mobility. Although, when the monitored mobility has come into existence then an enhancement of 18% in system throughput at a mobility of 2 m/sec has been obtained as when compared to random & predictable motions of the nodes. In future, the plan of adaptable monitored technique is proposed for WSN in which the routing path of the mobile target node regularly alters dependent on the direction of the data flow & consumption of node’s energy in order to enhance the QoS (Wakee U Ddin, et al., 2014).

Every node is capable to adopt the control over its transmission power dependent upon the RSS. To ensure the path connectivity in the moving circumstances, either the source node could fix its transmission power little higher than the least requisite to arrive till the CH, or else the CH can transmit the response information to every nodes of its environment to uplink or downlink the transmitted power. The major initiative in the sensor environment assisting the mobility in which the protocol must be capable to assist the movement of the node when there is an occurrence of the change in topology of the network. In accordance to the work shown here, an improved LEACH protocol, likewise LEACHMF has been suggested to expand the lifespan of the network & also to minimize the packet loss ratio for the mobile sensor network. In the said work, FIS has been chosen for the selection of the CH. Nodes that has more available energy, less mobility & longer pause duration will have the more possibility of getting elected as CHs. The resultant outputs says that by implemented the suggested LEACH-MF method, few enhancements in the lifespan of the network, optimization of the consumption of the energy, PDR & cluster deviation can be retrieved when contrasted with the few other conventional techniques. Therefore, it is trusted that LEACH-MF technique might be applied ahead to such environment which carries high number of mobile nodes (Jin-Shyan Lee, et al., 2017).

According to the above reference, the system throughput has been improved depending upon the incorporation of required allocation of power & blockage of the memory, a new technique of X-layer method is suggested. This technique of broadcasting produces excessive data rate with minimum utilization of energy over WSN. In this, X-layer active prediction congestion control (CL-APCC) & Joint CL techniques are compared. An integrated X-layer controlling technique is preferred to enhance the broadcasting throughput is suggested. The analysis of interference controlled allocation of the power & congestion in memory constraint has been done with a XL modeling, controlling at PHY & MAC layer is shown. The combination of the control algorithm is implemented over respective node in WSN in accordance to the blockage factor & interference level. An distribution of the power is monitored based on the response of the congestion factor. To obtain a high system throughput for alternative traffic situation, a supervising technique is implemented (K Prabhakara Rao, et al., 2010).

The work is implemented for observing the surveying outputs of star & mesh network. The results obtained after simulations finishes that the highest efficiency is observed in star network when a huge value of system throughput & data delivered is obtained in accordance to mesh topology. The system throughput of mesh network reduces sequentially where Zigbee Coordinator is not capable to respond with its communication with all the Zigbee End Devices available in the network. In continuation, the amount of data has been decrease. So, this work indicates the benefit of star topology to attain high system throughput along with high data communication in a regular interval of time for the architecture of Zigbee protocol (Bhumika, et al., 2015).

3. Methodology

The prediction of the movement of the sensor nodes is more or less difficult as the mobility parameter of the sensor nodes is not too much sensible. Although, in real-time applications, the sensor nodes represent a degree of continuity in the mobility pattern, & frequently represents non-random behaviour. In such conditions, there is a possibility of inter-relation of the next motion behaviour of the sensor node with its previous & present characteristics of the mobility. Henceforth, the models of memory-less mobility aren't not too much relating to the behaviour of the mobility. These patterns have been given attention to go after the motion behaviour of the mobile sensor nodes (Md. K. M., et al., 2019).

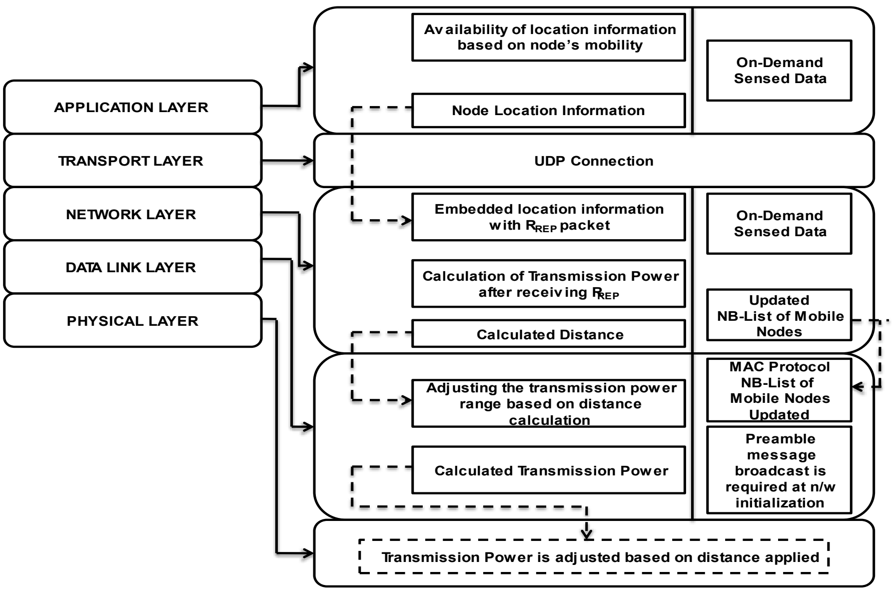

Figure 2 *Flowchart of MEP Model*

The residual energy calculations are very much essential so as to identify the status of the node for future communication as shown in Figure 2. This process of knowing of the residual energy is been obtained through adaptive beaconing protocol. This adaptive beaconing process helps in assisting the remaining energy level within the nodes available in the network environment. In this work, all the nodes such as stable & mobile are present. But, the role of nodes which are mobile plays a crucial role in calculation of the residual energy (M. K. M., et al., 2017).

DMRC algorithm suggests an alternative which is enhanced in sending the data via the minimal routes, either internal or external to the cluster in accordance to the spacing & the status of the energy of each node as shown in Figure 3. Therefore, DMRC algorithm implements a cost equation for every accessible routing path within the network. The source node transmits its information via the path that has the less cost. For reducing the energy load on the NXTHN, the DMRC suggests that the routing table of the source nodes will be reviewed after obtaining the updated information from their cluster member nodes. Corresponding to the cost equation, the source node transmits its information via the path that has less cost after updating the messages. By repeating this process, the DMRC algorithm enhances the state of the network & improves its stability. Also, it minimizes the consumption of energy which is essential for the data transmission (Md. Khaja, et al., 2017).

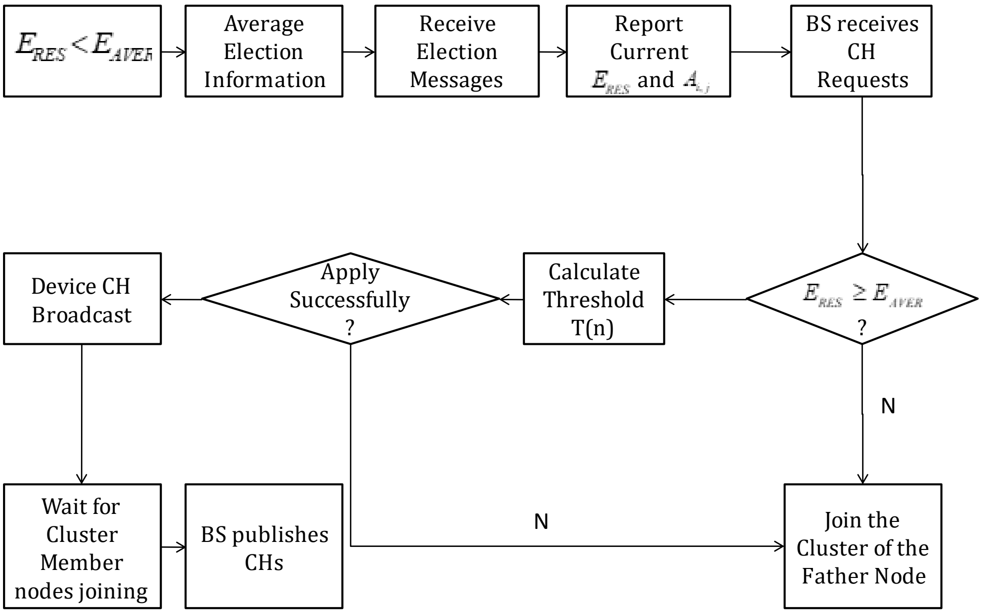

Figure 3 *DMHRC Process Flow*

RWS is the very effective & conventional stochastic selection method suggested by Holland. It is illustrated under the ratio selection as it permits each node relevant to the possibility ratio to the value of the fitness. The theory of RWS is a linear search through the wheel in which the wheel will be weighted in accordance to each node's value of the fitness. Entire nodes in the population are deployed on the RWS in accordance to the value of the fitness. Individual node is allocated with a division of RWS. The dimension of each division in the RWS represents the ratio of the value of the fitness of each node – the higher the value of fitness is, the higher the division will be. Thereafter the virtual RWS is rotated. Each node relevant to the particular division on which RWS halts is thereafter chosen. This procedure re-iterates till the required count of entities are chosen. Entities with high value of fitness will have high possibility of getting chosen which may results in biased selection in favor of high value of fitness of the entities. It could also probably neglect the efficient entities of the residents. There's no assurance that best entity will search their direction into upcoming production. RWS prefers utilization method in its selection (D. Kothandaraman, et al; 2019).

Firstly, a node which is interested to enter the network must satisfy the organization process (Hemlata Sinha et al; 2020). If the respective device/node is not a FFD, then it requests to be linked with a FFD which acts as organizer, else the node requires the list of its adjacent neighbours so that it could schedule its super-frame & transmission time of the beacon. Therefore, it needs 2 primitives likewise: MLME_NLIST & NEIGHBOR_SCAN as in Figure 4.

Utilizing the NEIGHBOR_SCAN primitive, node engages its NB-List & sender duration of the beacon; henceforth it verifies them in NB-Table. Via MLME_NLIST primitive, the device communicates a neighbour list instruction is preferred to achieve super-frame processing of its adjacent nodes after which the nodes finish its neighbour table. With respect to the values of SO & BO, many numbers of super-frame involved in beacon gap is evaluated. If it doesn't search any blank slot, then the node operates as the end device, else it allocates the blank slot to itself & starts to broadcast the beacons in the respective time slot (Md. K. Mohiddin, et al; 2019).

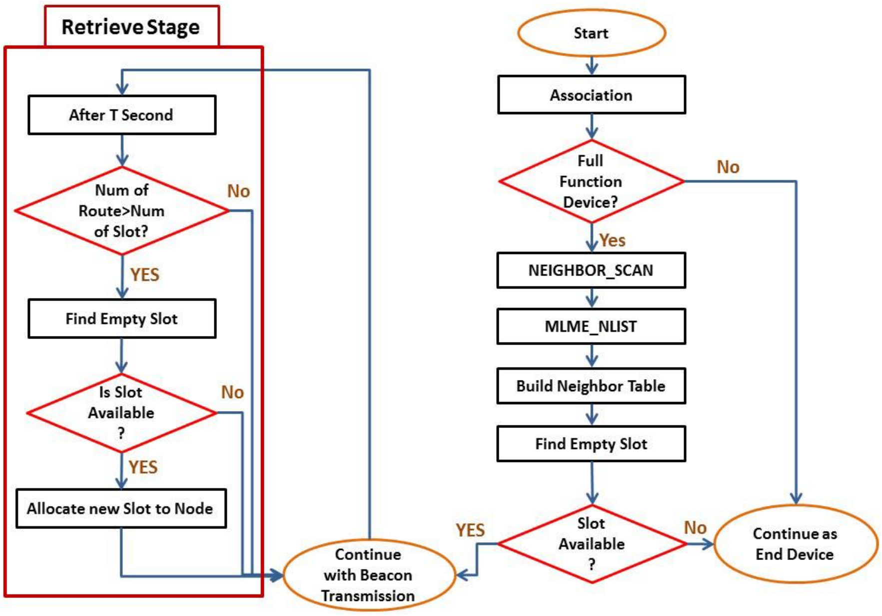

Figure 4 *LAB Scheduling Algorithm*

Results

Table 1 *Simulation Metrics*

Simulation Metrics	Specifications
No. of nodes	10, 20, 30, 40, 60, 80, 100……..300
Initial Energy	100 Joules
Mobility	1m/s – 3m/s
Radio Propagation Model	Two Ray Ground Model
Transmission Range	250 meters
Simulation Time	50 seconds
Routing Protocol	M-AODV
MAC Protocol	IEEE 802.15.4 with 868 MHz
Transport Protocol	UDP
Traffic Type/Model	CBR
Packet Size	100 bytes
Queue Length	150 packets
Design	Cross-Layer Approach

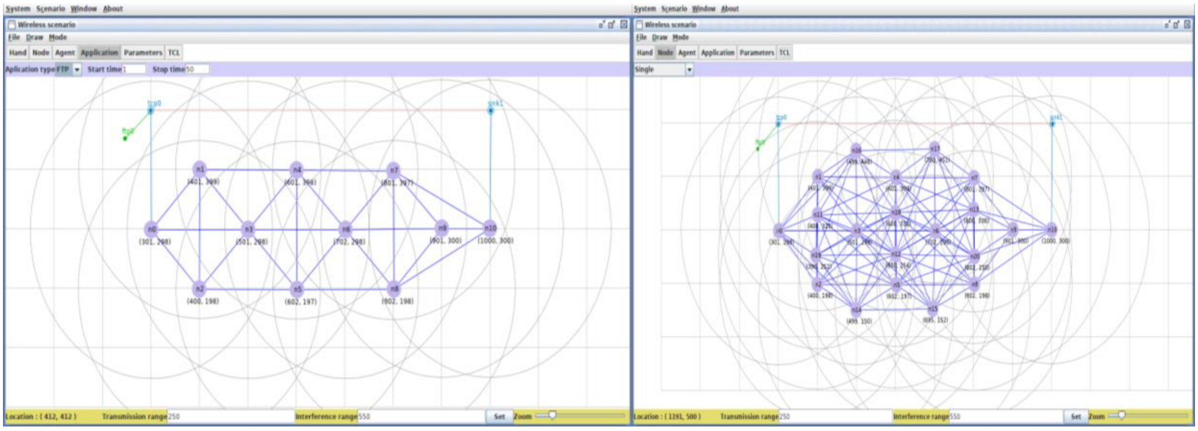

Figure 5 *Wireless Sensor Node Deployment Scenario for 11 Nodes & 21 Nodes*

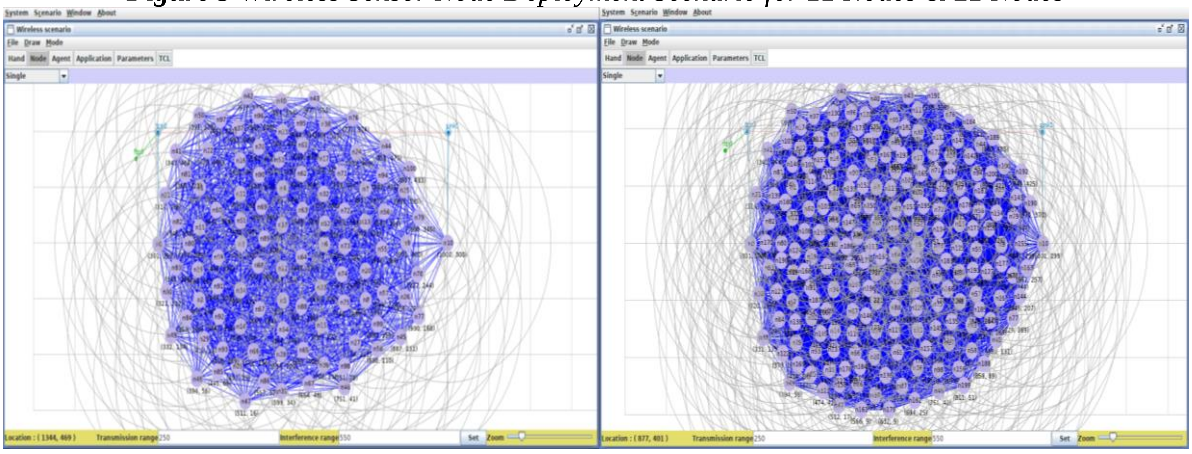

Figure 6 *Wireless Sensor Node Deployment Scenario for 101 Nodes & 201 Nodes*

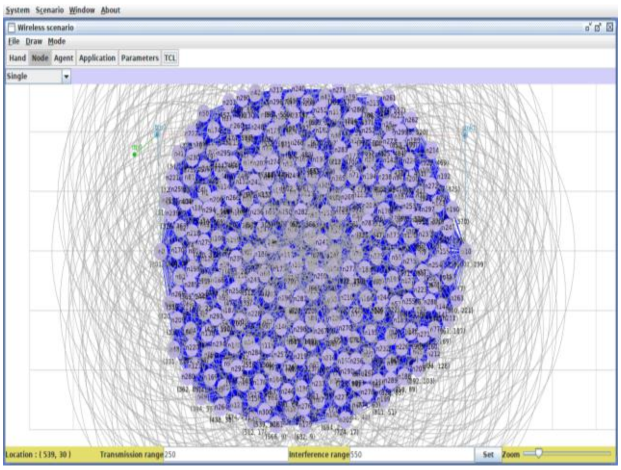

Figure 7 *Wireless Sensor Node Deployment Scenario for 301 Nodes*

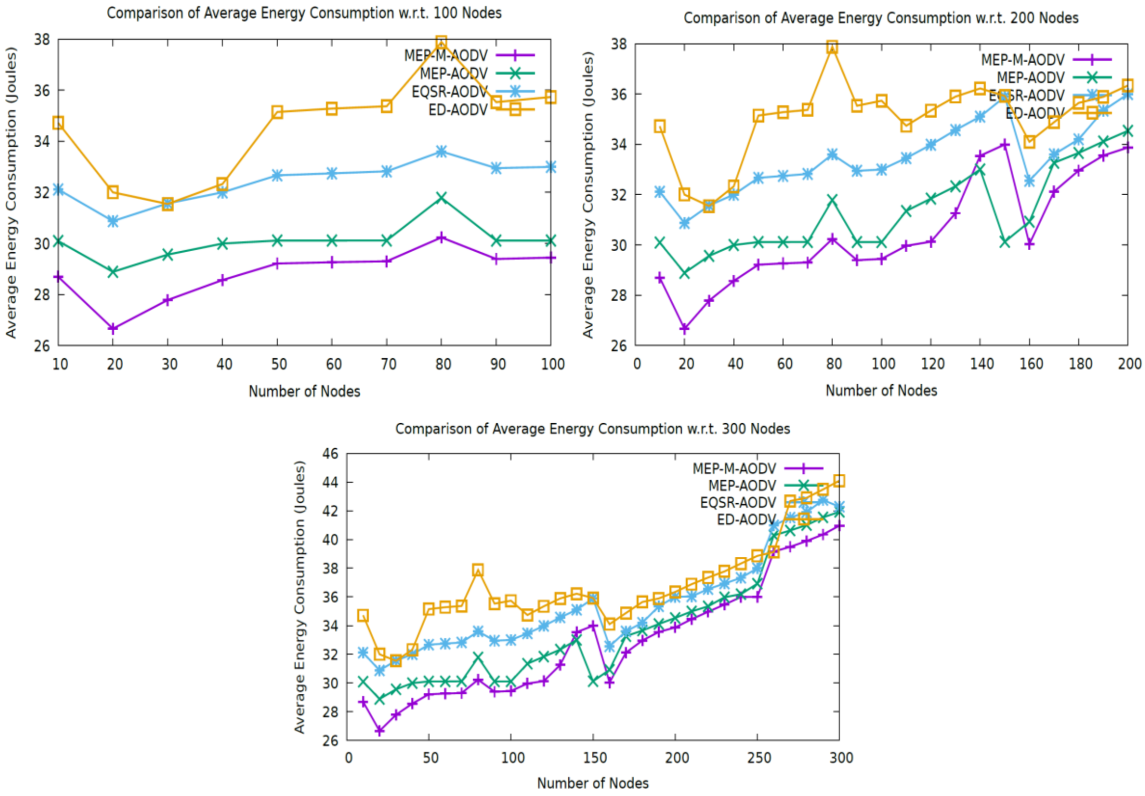

Figure 8 *Results of Average Energy Consumption for 101, 201 & 301 Nodes*

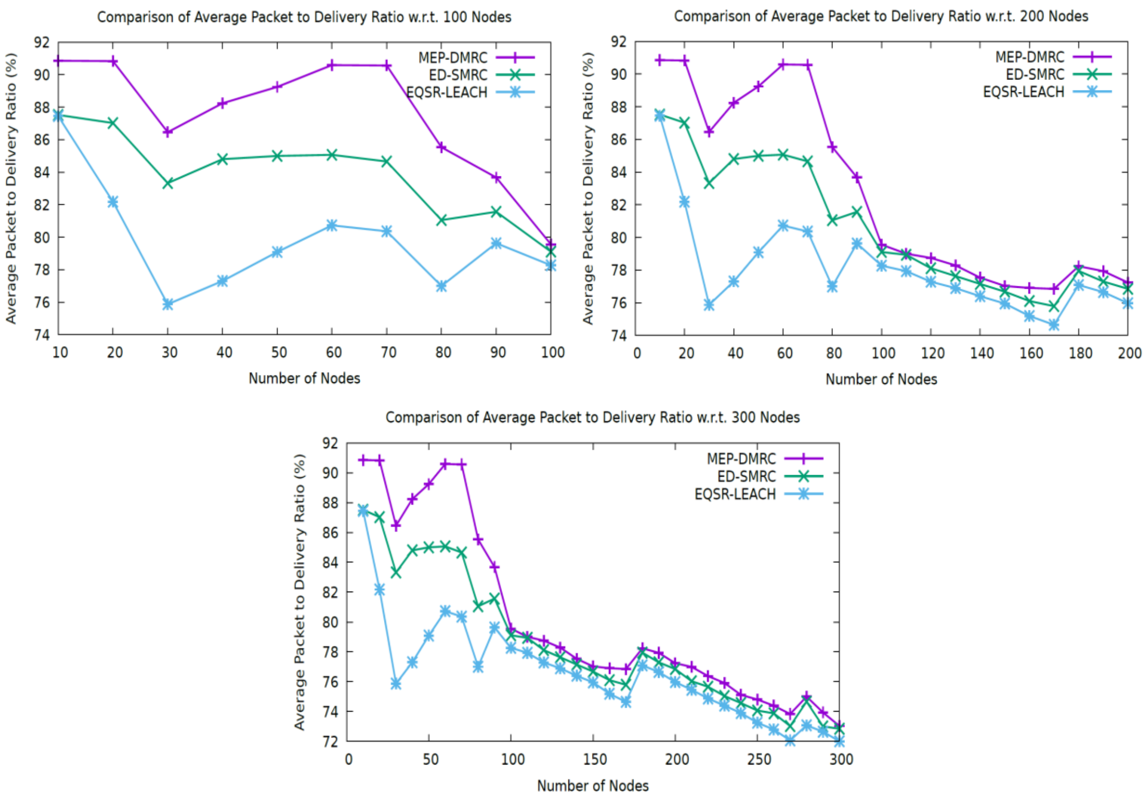

Figure 9 *Results of Average Packet to Delivery Ratio for 101, 201 & 301 Nodes*

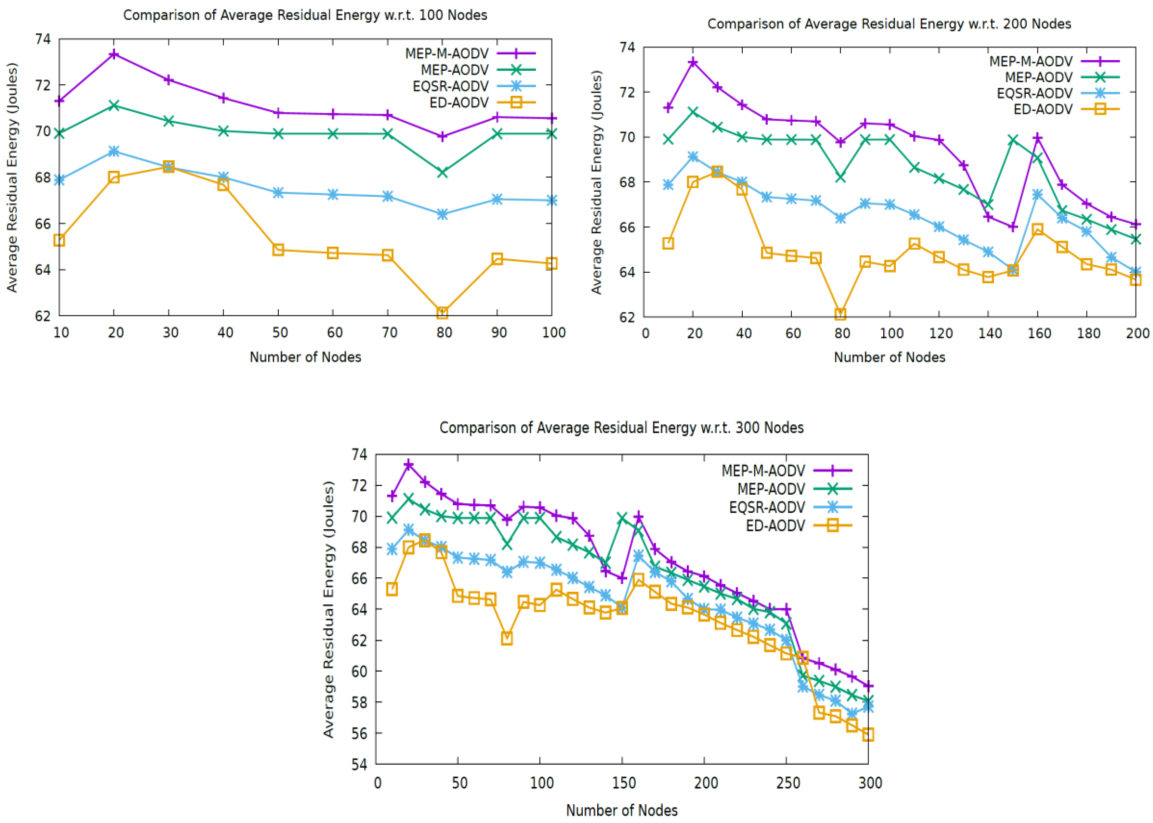

Figure 10 *Results of Average Residual Energy for 101, 201 & 301 Nodes*

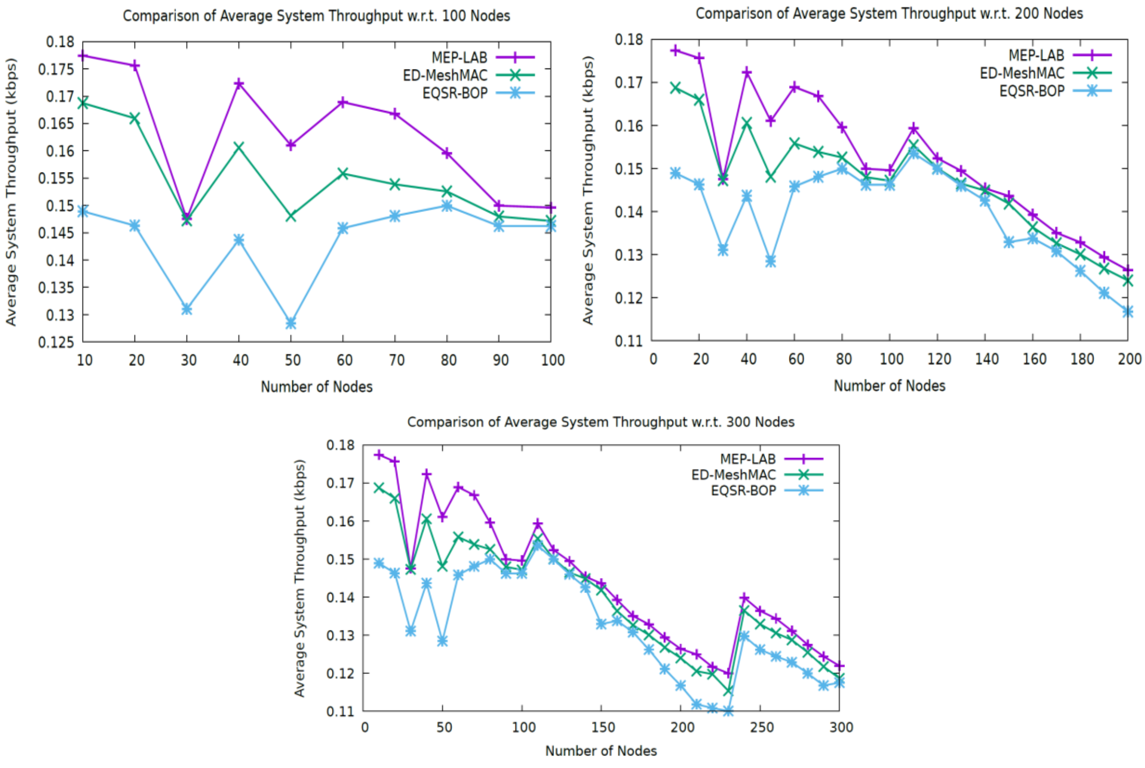

Figure 11 *Results of Average System Throughput for 101, 201 & 301 Nodes*

Conclusion & Future Scope

The results of Average Energy Consumption as per Figure 8 of the Proposed MEP Model using M-AODV over EQSR, ED and MEP with AODV is performing good. The results of Average Residual Energy as per Figure 9 of the Proposed MEP Model using M-AODV over EQSR, ED and AODV is providing better performance. The results of Packet to Delivery Ratio as per Figure 10 of the Proposed DMRC Protocol over LEACH Protocol and SMRC Protocol is providing better performance. The results of System Throughput of the LAB Scheduling Algorithm along with RWSM as per Figure 11 for MEP Model over BOP Scheduling Algorithm for EQSR Model along with GSM and MeshMAC Scheduling Algorithm for ED Model along with TSM is providing better performance. By applying the Mobility Error Prediction Algorithm to various cross layer approaches can enhance the remaining parameters of the WSN such as node's location, end to end delay, packet overhead, latency etc. The Load Adaptive Beaconing Scheduling Algorithm can also be examined for multiple clustering techniques according to the requirement of the parameter to be improved.

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