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Routing Path Estimation Based on RWS Method for Competent Energy Dissipation Employing X-Layer Network

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Abstract*: In this paper, the implementation of Mobile Error Probability algorithm has been implemented to improve the output efficiency of the sensor nodes in the wireless network environment. According the WSNs is concerned, it's very important to focus on residual energy of each node. The Mobile Error Probability algorithm support to this very strongly, it ultimately calculates the residual energy corresponding to the consumed energy by the node at each level of the beaconing. This is only applicable for the mobile node depending upon the distance between the nodes. If the distance exceeds the set limit, then only the node sends the beaconing signal else it will be in idle state. Besides, the above concept, the method of RWS is also been implemented to estimate the routing path which can be used for the transmission in minimum stipulated of time. Scheduling algorithm has been used for proper cycling of the node in various modes such as active, idle, sleep and dead conditions. All the above algorithms are been implemented in EQSR, ED as well as proposed model using NS-II simulation through results are also been examined.

Index Terms*: 2-Ray Ground Propagation Model, AODV Protocol, Average Energy Consumption, End-End Delay, IEEE 802.15.4, Number of Alive Nodes, Roulette Wheel Selection (RWS) Method, System Throughput.

I. INTRODUCTION

According to WSNs are concerned, the effectively model which is been used highly is the X-Layer model. Primarily, is to control the number of control packets which are been transmitted in the network area to share the support for the channel used for communication existing within the nodes. The optimization methodology of the controlling the packets has its reaction on the packets which transmits the NB-List hello packets in the routing layer stage. Secondly, is the concept of transmission power control system which is exactly proportional to the destination of the corresponding node. The mentioned system is active immediately followed by the route discovery process or else immediately after the establishment of the route.

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Summing the above two important mechanisms results in efficient energy dissipation, extensive system throughput, less end-end delay and high PDR [1-2]. As per the future scope of the model which is been proposed in this paper is to reduce the control packet overhead more and more focusing on route request packets also as it is been considered as broadcast packets. A technique which is possible to execute is to focus on the mobile nodes so that the node can knew the exact location of the sink nodes. Thereafter, by executing the directional broadcast, the agenda of the size of control packets have to be optimized so that they are been transmitted as well to enhance the Communication channel quantity. Apart from the above, it is also possible to have complex solved information about the network lifetime of the active routes. Therefore, by combining the information of the mobile nodes direction as well as mobility, the active routes can be reassembling to have long network lifetime. Such system can optimize the messages of link error handling which exists within the nodes [1]. An MEP and CMHR protocol is been implemented here. The X-Layer network approach has been selected as the enhanced layer approach which is comprises of, MAC/Data link layer which is meant for sharing the information corresponding to various energy levels, link capacity and RSS values which also behaves like service provider too.

A. Network layer which is meant to establish the medium in between the communication protocols likewise TCP (or) UDP.

Besides the above mentioned layers, transport layer also exists which is meant for controlling the communication via FTP/STTP/CBR. The concept behind this it's feasibility for indoor automation applications. By developing this MEP model, the estimation of the residual energy levels has been done. Apart from the above, with the support of CH election method corresponding to CMHR as shown in Fig 1, it has very easy to select the required cluster head within the same region to which it actually relates to. AODV including 2-ray ground propagation model has been taken into consideration to evaluate efficient results with respect to the parameters used. It has been observed that, the proposed model of the enhanced algorithm performs better when compared to the conventional models (EQSR, ED) based on the parameters likewise average energy consumption, end-end delay & system throughput [4-5]. Sink node encodes its present position information to a novel established surrounding as route repeat request and thereafter transmits it to the upcoming possible hop within the desired route.

Remaining all the other nodes which lies along the same path also encodes there location information in route repeat request packet and then forwards it to the nearby hop available next to it. The nodes existing in-line with the path calculates the distance within each neighbor node. The estimated values are therefore forwarded to the MAC layer which computes the required transmission power depending upon the values of the distance. This complete process is done at the physical layer level. The data packets were permitted to interchange only within the route, which therefore reduces the broadcasting of the control packets [6].

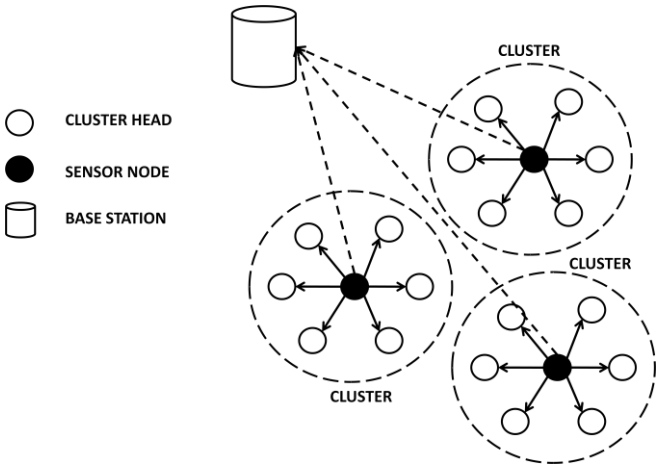

Figure 1 Cluster Multi-Hop Routing Model

According to the proposed model based on novel technique I-XLP for wireless sensor networks which utilized the knowledge of gradient in routing procedure as per the deployment shown in Fig 2; MAC layer duty cycle & congestion control by tuning the actual information which are been processed in the order of cross layered manner which results in minimum efficiency. In future, the work extends in form of analytical method based on protocol design application spaces of WSNs [10]. A controlling approach is been presented to enhance the system throughput utilizing the x-layer interfacing. In current scenario, communication oriented networks acquire optimal interference with high accuracy including high speed data rate. Enhancement of the throughput has been identified as a major issue in placing the broadband WSNs. With respect to the integration of the essential power allocation & memory blockage, a optimistic method of x-layer integration system has been proposed which also delivers high speed data rate with less energy dissipation over WSNs [9]. It takes into the account regarding the various applications of the nodes with mobility as well its tracking. Firstly, all the sensor nodes are deployed in regular procedure and thereafter to operate the sensing circumstances, all the mobile nodes revolve around a stationary deployment environment. Apart from the above, energy dissipation due to the mobility is not been taken into consideration in the performance evaluation process since the sensor are been presumed along with the drones. Every sensor node has the ability to either operate in sensing mode to supervise the environment & also to transmit the data to relevant CH as shown in Fig.1 or CH mode to collect the data which further forwarded to the base station. The data collected by the CHs is transmitted to such a base station which is established outside the deployment environment.

Apart from all of these assumptions, they are few more as follows:-

1. All the sensor nodes are been considered as mobile nodes.
2. The base station location is static.
3. The network is identical & each node has the uniform initial energy.
4. Each node knew about its own residual energy, mobility speed, & pause time duration during simulation.
5. Each node is having the tendency to oversee its transmission power relevant to received signal strength.

To confirm the connectivity of the line metrics in a mobile surrounding, either the transmission power of the sensor node is adjusted in such a way that it is slightly more than the least requirement to reach the CH, or else the CH should have to possibility to transmit the RREP messages to each of its sensor nodes to higher or lower the corresponding transmitted power [12]. The usefulness of WSN in the industrial circumstance with precise necessity of latency as well as data integrity, is the most demanded topic for which zigbee employs few MAC layers selected to satisfy the basic essential needs. In this paper, it determines two various systematic strategies, relevant to the super-frame composition in a TDMA beacon enabled environment [19].

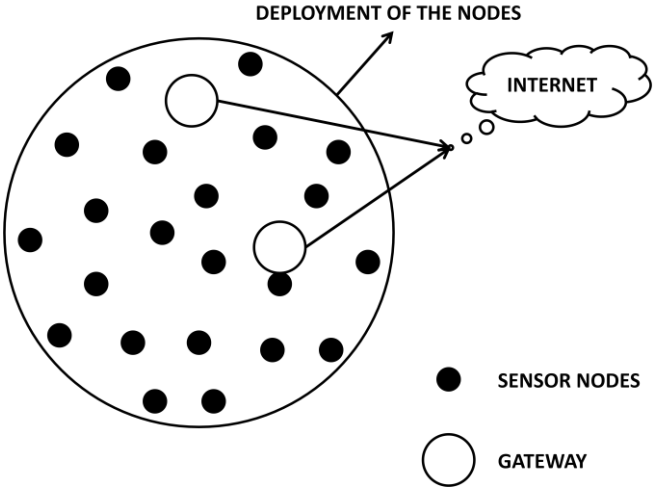

Figure 2 Deployment of the Nodes

II. LITERATURE REVIEW

The main agenda of this paper is the regular mobility of the deployed nodes that can sense and what will be the impact on the n/w operation in the link connectivity as well as position up-gradation of the sensor nodes. The link connectivity consequences is been avoided by utilizing the routing & MAC protocols as above layers are reliable of delivering an available link within one hop to other. The position up-gradation information is the attachment of the application layer, in-spite of that, it also enables a specific system to find out the exact location of the sensor nodes which are having even less mobility via EQSR technique [1].

During the initialization of the n/w, the mobile node initiates to deliver the NB discovery information to validate NBs information accumulate & save the same in the NB List. As soon as the deployment task is finished, thereafter if a node in the n/w has the data of interest to be send, which contains the information of the nodes' location as well as position of the mobile node which is provided by the GPS [2]. To map the individual parameter performance of the XLN optimization model simulations has been evaluated & shown using NS-II simulator. The proposed model also executes the XLN n/w, but the only change is when mapped to the conventional model in which mobility aware protocol has been proposed for estimating the mobility through which high mobile nodes can be seen via which NB list can be up-graded which results in minimization of the energy dissipation with long n/w lifetime [3]. In accordance to the cited reference, the energy dissipation variable has been drastically optimized with reference to the application of the transmission power control system for dynamically varying the transmission power related to the Energy-Degree (ED) Model which performs better when simulated along with EQSR & XLN model [6]. Residual energy levels has taken into account along with the energy dissipation variable which is based upon the clustering in relevant to the routing algorithm, the GCCR has been performed better in comparison with LPGCRA & GCRA [7]. The system integration of the measurable power allocation & memory blockage results in system throughput parameter in XLN protocol. This integration results in lower energy dissipation, high speed data rate [9]. Energy Dissipation plays a complex role in designing of the sensor network. One of the most successful approach for the energy saving is the hierarchical clustering design by which, the network lifetime enhances as well as reduces the packet loss drawback [12].

III. COMPARISON OF EXISTING SYSTEM WITH THE PROPOSED MODEL

As per the existing system is concerned, the cross layer approach has been implemented to compensate the drawbacks occurred in the energy consumption. Apart from this, the WSN also suffers from huge link failures. To overcome the above problems in the existing system, an innovative approach is been proposed in this paper combining 3 different algorithm to minimize the issues occurring in the existing model.

Table 1 Comparison of EQSR, ED and Proposed Model

TYPE OF PROTOCOL USED	EQSR	ED	PROPOSED
ALGORITHMS USED	Genetic Routing Algorithm & (AODV)	Pseudo Code Algorithm & (AODV)	Mobility Error Prediction Algorithm & (M-AODV)
	Beacon Routing Algorithm	-	Adaptive Beaconing Routing Algorithm
ADVANTAGES	Used to find the best path for routing considering all the nodes	Adjustment of Transmission Power	It uses only Mobile Nodes & Distance is calculated using Euclidean
		Power Calculation & Distance Calculation	Optimum Energy Consumption
DRAWBACKS	It suffers from broadcast overhead, if node shows high mobility	No Beaconing is used	Used for Limited Data Rate Applications
	Consumes more energy in route establishing phase	Consumes more energy as the packets are sent to each node	-

Firstly, by identifying the nodes which are mobile and also considering the static nodes for future communication which minimizes the energy consumption, Secondly, election of proper cluster head so as the node can stay within the same cluster for longer duration to avoid link failures. Also, by implementing the multi-hop clustering along with the above two algorithms. By contrasting all the 3 algorithms, we can observed maximum changes in the energy consumption with less packet loss and deserved system throughput.

IV. METHODOLOGIES USED

***Algorithm I: -* Error Prediction of the Node Mobility for Next Possible State**

Step 1: Mean Distance in 'a' direction

$$P(\mu_a) = \frac{a_1t_1 + a_2t_2 + a_3t_3 + \ldots\ldots + a_kt_k}{k} \tag{1}$$

Step 2: Mean Distance in 'b' direction

$$P(\mu_b) = \frac{b_1t_1 + b_2t_2 + b_3t_3 + \ldots\ldots + b_kt_k}{k} \tag{2}$$

Step 4: Distance Variation

$$D = \{a_i + P(\mu_a)\}^2 + \{b_i + P(\mu_b)\}^2 \tag{3}$$

Step 5: Consumed Energy

$$E_C = \{E_{RX} \times N_{RX}\} + \{E_{TX} \times N_{TX}\} + \{E_I \times N_I\} + \{E_S \times N_S\} \tag{4}$$

Step 6: Residual Energy

$$E_R = Remaining\ Energy\ Level = Initial\ Energy - E_C \tag{5}$$

***Algorithm II: -* Dynamic Matrix Formation Based Routing Path Estimation**

Step 1: Initialize the Matrix with Roulette wheel selection methods

$$M = \begin{Bmatrix} a_1 \\ a_2 \\ \cdot \\ \cdot \\ a_n \end{Bmatrix} = \begin{Bmatrix} (s, a_{11}, a_{12}, \ldots, a_{1l}, d), \\ (s, a_{21}, a_{22}, \ldots, a_{2l}, d), \\ \cdot \\ \cdot \\ (s, a_{n1}, a_{n2}, \ldots, a_{nl}, d), \end{Bmatrix} \tag{6}$$

$$P(i,j) = \begin{Bmatrix} \dfrac{\sum_{k\epsilon N_i}(h_k) - h_j}{(C(N_i) - 1) * \sum_{k\epsilon N_i}(h_k) - h_j} & if(j\epsilon N_i) \\ 0 & else \end{Bmatrix} \tag{7}$$

Where "h_k" denotes the no. of the hops of node k till the sink node; similarly, h_j represents the no. of hops of node 'j' till the sink node; N_i is the array of NB nodes of node 'i', assuming the nodes are already exist in current forwarding path; C (N_i) is the capacity of set N_i.

Step 2: Estimate the condition of each link path in HM
Step 3: if (t=0)
{ Choose a new path
Estimate the condition of the chosen path
}
Step 4: t=t+1
Step 5: if (if path (i+1) is good enough than the path (i)
Step 6: path (i) ←path (i+1) // efficient path is chosen on behalf of the failure path
Step 7: else
Step 8: if ($t<t_{max}$) than
if (adjacent path. true(r+1)) than
Simulate local search for the $(r+1)^{th}$ path
End
Step 9: Estimate the condition of the path produced with local search, t=t+1
Step 10: if (path produced is good enough than (r+1) then
Step 11: Restitute the $(r+1)^{th}$ path with new path in HM
Step 12: End

***Algorithm III:* - Scheduling Algorithm**

Here, a scheduling algorithm is also been proposed which helps us to improve the n/w lifetime by maintaining sufficient coverage. Sensors with overlapping coverage areas of more than fifty percent are turned off to save energy and are woken up at the appropriate time to extend the network lifetime. Each sensor implements the algorithm independently. The sensor can be in any of the four states: Active, Sleep, Idle and Dead. Each active sensor will try to enter the sleep mode from where after a specific time interval it goes back to the active mode again. The sensor node can also enter the idle mode from the active mode after which it enters the dead mode where it is terminated if it has low energy. The node wishing to enter the sleep mode, first checks the neighbors whose overlap of sensing area is greater than fifty percent and broadcasts a sleeping request (SR) message to all neighbors. If all the neighbors agree the node can enter the sleep mode. If any of the neighbors rejects, the node keeps the trial active and attempts again after a predefined time. The neighboring node which receives this request (SR) recalculates the coverage ignoring the requesting sensor. If the coverage is sufficient then a positive acknowledgment (PAK) is given else a negative acknowledgment (NAK) is given. Multiple sensors can move to the sleep mode simultaneously provides an advantage to our algorithm. It is necessary that only one sensor within the neighborhood is permitted to transmit a RREQ at a time. Neighbor nodes randomly contend with each other to avoid collisions. We assume sensor nodes whose sensing range overlaps with each other can communicate directly 13. We also assume the sensor node knows the location of the neighboring sensor nodes [42]. Fig 3 shows the state transition diagram of the algorithm. According to RWS method, all the sensor nodes within the scenario have been deployed in accordance to their residual energy values. Each node is assigned with a segment of the RW. The size of individual segment is almost proportional to the residual energy of the individual, the more the residual energy, the larger the segment size. Thereafter, the spinning process of the RWS has been initiated. Those segments have been taken into consideration where the roulette wheel stops; the same is repeated again and again until the required number of the individual nodes chosen. More the residual energy value of the nodes more is the probability of selection.

The whole cycle of RWS is as follows:-

1. Identifying the residual energy of each node.
2. Residual energy is been selected by comparing it with the threshold value.
3. Identifying the no. of nodes in individual cluster.
4. Higher the residual energy value, more will be probability of selection for transmission.

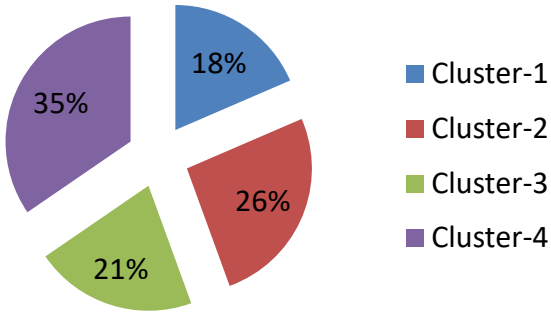

Figure 3 Roulette Wheel Selection Method

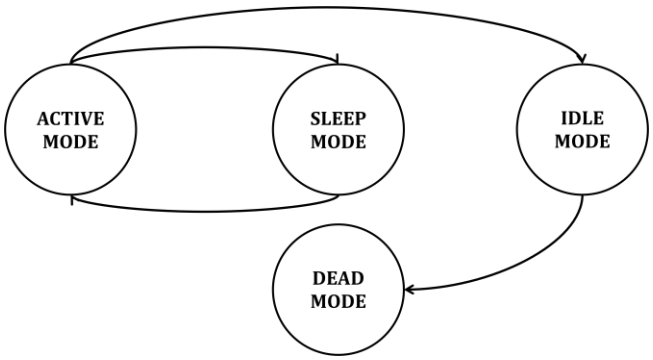

Figure 4 State Transition Diagram of the Scheduled Algorithm

i. **PMR** (PHY-MAC-ROUTING)
   a. **CARP** – Collision Aware Routing Protocol
   b. **CLB** – Cost Link Based
   c. **LDCE** – Link Distance Cost Link Error

ii. **MR** (MAC-ROUTING)
   a. **SCL** – Clustering Routing Based
   b. **BRP** – Balanced Routing Protocol
   c. **EECLC** – Energy Efficient XL Clustering

d. **EERCP** – Energy Efficient XL Protocol
e. **CL-MAC** – Cross Layer MAC

iii. **PMRA** (PHY-MAC-ROUTING-APP)
a. **ARP** – Adaptive Routing Protocol

iv. **PMRT** (PHY-MAC-ROUTING-TRANSPORT)
a. **XLP** – Cross Layer Protocol

Table 2 Evaluating Various Parameters with Different types of Protocol

TYPE	PROTOCOL	SIMULATOR	EC	PL	OH	TP	EED	RE
PMR	CARP	NS-II	L	L	L	H	L	L
	CLB	NS-II	L	-	L	H	H	H
	LDCE	NS-II	L	L	L	H	H	H
MR	SCL	NS-II	L	H	H	H	L	-
	BRP	NS-II	L	L	H	H	-	L
	EECLC	NS-II	L	L	H	H	-	-
	EERCP	NS-II	L	L	H	H	-	-
	CL-MAC	NS-II	L	L	-	H	-	-
PMRA	ARP	NS-II	L	L	H	H	L	H
PMRT	XLP	NS-II	L	L	L	H	L	H

Table I elaborates the comparison of various parameters such as
EC – Energy Consumption,
PL – Packet Loss,
OH – Packet Overhead,
TP – System Throughput,
EED – End-End Delay and
RE – Residual Energy with respect to the various approaches [43].

V. RESULTS

The Energy Calculations are been made in accordance to the below equations as per the various approaches are concerned.

For **EQSR Model**,

$$E_{Node\_Consumed} = E_{T_X} + E_{R_X} + E_{Idle} + E_{Sleep} + E_{RREP_{AODV}}$$

$E_{Node\_Consumed}$ = Energy at each node
E_{T_X} = Transmitted Energy
E_{R_X} = Reception Energy
E_{Idle} = Energy of the Idle Nodes
E_{Sleep} = Energy of the Sleep Nodes
$E_{RREP_{AODV}}$ = Energy during route establishment phase

For **ED Model**,

$$E_{Node\_Consumed} = E_{Ph-I_{AODV}} + E_{Ph-II_{AODV}} + E_{T_X} + E_{R_X} + E_{Other}$$

$E_{Node\_Consumed}$ = Energy Consumed at each node
$E_{Ph-I_{AODV}}$ = Energy w.r.t. Route Request Packets
$E_{Ph-II_{AODV}}$ = Energy w.r.t. Route Reply Packets
E_{T_X} = Transmitted Energy
E_{R_X} = Reception Energy
E_{Other} = $E_{Idle} + E_{Trans.\ Power} + E_{Sleep}$

For **Proposed Model**,

$$E_{Node\_Consumed} = E_{T_X} + E_{R_X} + E_{Idle} + E_{Sleep} + E_{RREP_{AODV}} + E_{Trans.\ Power}$$

$E_{Node\_Consumed}$ = Energy consumed at each node
E_{T_X} = Transmitted Energy
E_{R_X} = Reception Energy
E_{Idle} = Energy of the Idle Nodes
E_{Sleep} = Energy of the Sleep Nodes
$E_{RREP_{M-AODV}}$ = Energy during route establishment phase w.r.t to M-AODV protocol

Considering the $E_{Node\_Consumed}$ of all models whose results are plotted in Fig 5 and Table 3, the average energy consumption has been evaluated by:

$$Average\ Energy\ Consumption = \frac{E_{Node\_Consumed}}{No.\ of\ Successful\ Packets\ Transmitted}$$

Corresponding to the above average energy consumption, the residual energy has been evaluated using the formula

$$E_{Node\_Residual} = E_{Node\_Initial} - E_{Node\_Consumed}$$

$$Average\ Residual\ Energy = \sum \frac{Residual\ Energy\ of\ the\ Individual\ Node}{Total\ Number\ of\ Nodes}$$

These results are shown in Fig 6 and Table 4.

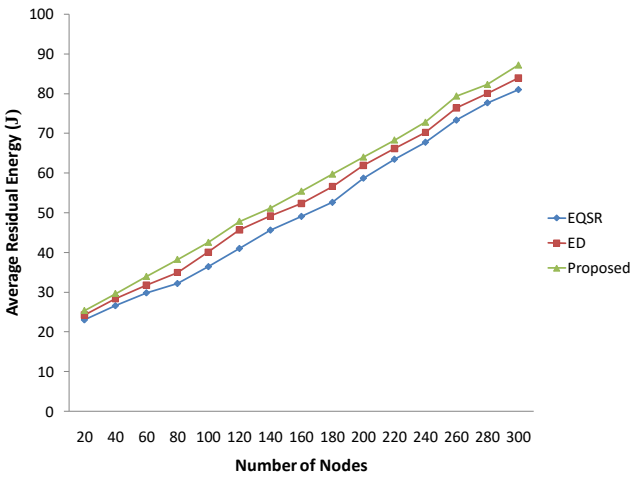

Figure 5 Average Energy Consumption in micro joules

Table 3 Comparison of the existing with proposed models

No. of Nodes	EQSR (Avg. Energy in µJ)	ED (Avg. Energy in µJ)	Proposed (Avg. Energy in µJ)
20	8.541	8.495	8.199
40	8.141	8.106	7.867
60	7.682	7.545	7.432
80	7.263	7.128	6.876
100	6.833	6.818	6.449
120	6.404	6.393	5.973
140	5.974	5.966	5.364
160	5.545	5.538	5.011
180	5.115	5.023	4.666
200	4.686	4.674	4.205
220	4.256	4.211	3.747
240	3.827	3.799	3.323
260	3.397	3.383	3.088
280	2.968	2.849	2.765
300	2.539	2.527	2.409

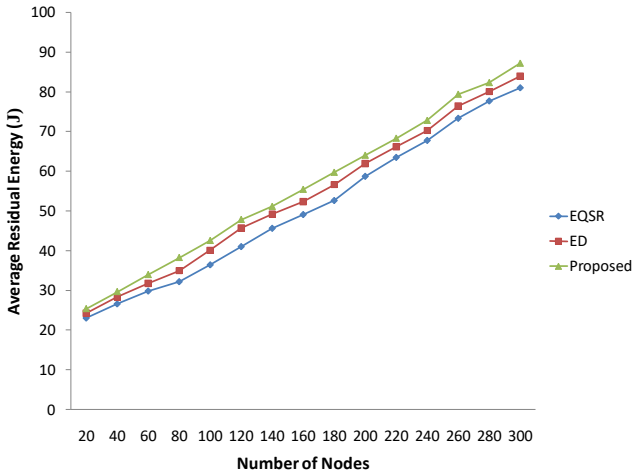

Figure 6 Graphical Analysis of the Residual Energy of all the 3 models

Table 4 Comparison of Values of the Residual Energy of the 3 models

No. of Nodes	EQSR Avg. Res. Energy(J)	ED Avg. Res. Energy(J)	Proposed Avg. Res. Energy(J)
20	23.09	24.27	25.386
40	26.65	28.37	29.680
60	29.88	31.83	33.975
80	32.23	34.99	38.269
100	36.47	40.13	42.564
120	41.05	45.74	47.858
140	45.66	49.23	51.153
160	49.11	52.38	55.447
180	52.64	56.66	59.742
200	58.73	61.93	64.036
220	63.49	66.18	68.331
240	67.76	70.28	72.821
260	73.32	76.45	79.412
280	77.67	80.06	82.333
300	80.99	83.95	87.219

With respect to the Fig 9, it is been observed that the value of 50 is set to be producing high output, whereas the value of 25 is set to be producing very low output. These both values are been considered just to analyze the characteristics of various protocols in different situations.

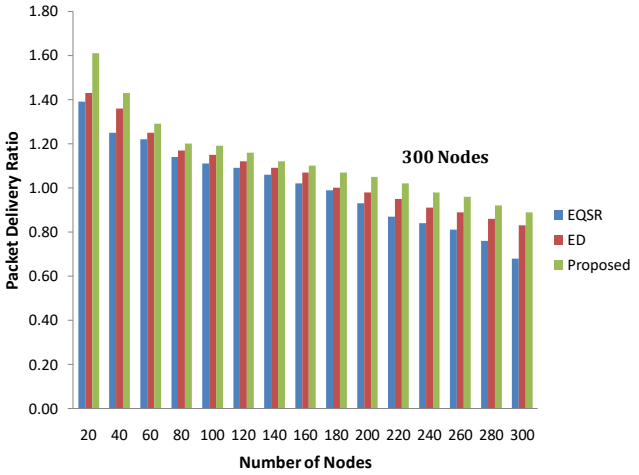

Figure 7 Graphical Values of PDR

Table 5 Comparison of PDR with all the 3 Models

No. of Nodes	EQSR (PDR)	ED (PDR)	Proposed (PDR)
20	1.39	1.43	1.61
40	1.25	1.36	1.43
60	1.22	1.25	1.29
80	1.14	1.17	1.20
100	1.11	1.15	1.19
120	1.09	1.12	1.16
140	1.06	1.09	1.12
160	1.02	1.07	1.10
180	0.99	1.00	1.07
200	0.93	0.98	1.05
220	0.87	0.95	1.02
240	0.84	0.91	0.98
260	0.81	0.89	0.96
280	0.76	0.86	0.92
300	0.68	0.83	0.89

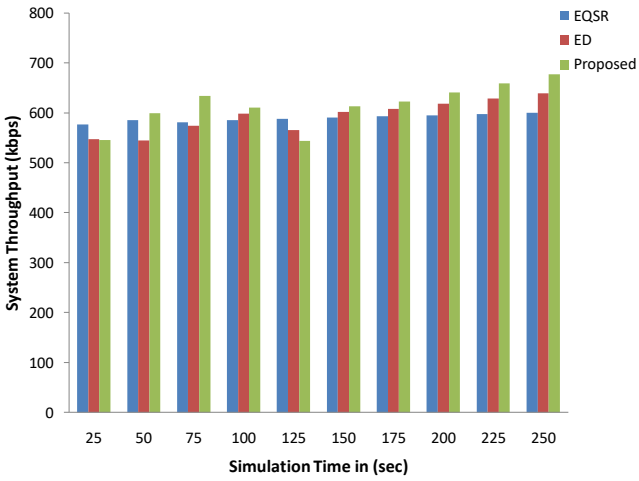

Figure 8 Graphical Obtained Values of System Throughput w.r.t. simulation time

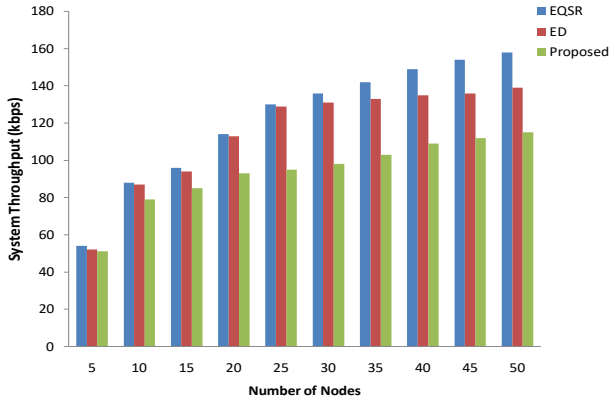

Figure 9 Graphical Obtained Values of System Throughput w.r.t. Number of Nodes

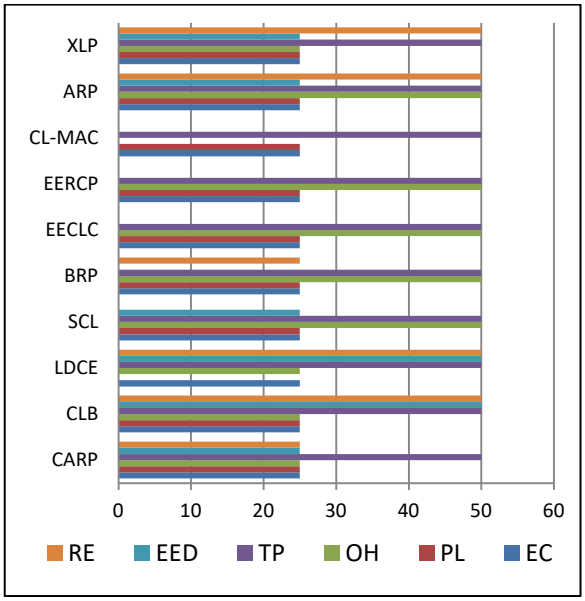

Figure 10 Comparison with various protocols w.r.t the Bar Graph

VI. CONCLUSION

To overcome with the problem of energy consumption with respect to the nodes, the mobile error prediction algorithm has been implemented to justify the distance so that if it is greater than the limit, then the node with high mobility will be sending the beaconing signal so as to be aware of the remaining residual energy within it. Apart from the above, the roulette wheel selection method has also been used over here to estimate the exact routing path with minimum distance to reach the destination via RWS. Also the scheduling algorithm has been performed to make a note the actual condition of the node whether it is in the active, sleep, idle or dead state. Depending upon the energy available with the node, it will decide to proceed further for the communication within the network or not. The work based on the comparison of various parameters with respect to different protocols has been done, through which it is clearly understood that, the X-Layer Network is outperforming good. The results have been evaluated and compared with the conventional models such as EQSR and ED with the proposed model based on 3 algorithms is much better and efficient relevant to RWS. Further the work can also be extended comparing by taking few more parameters into consideration based on its scalability.

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