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Execution of LEACH Intended for Curtailing Energy Consumption in Wireless Networks

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Abstract: *WSN (Wireless Sensor Network) is an integral part of WANETs (Wireless Sensor Networks). LEACH protocol is a prominent protocol in which nodes transmit to CH (cluster heads) and CHs collect and compress the data and data is forwarded to the base station which acts as a sink.The research paper implements LEACH protocol under different circumstances by altering number of operating nodes, size of data package, number of clusters, number of rounds, and calculating energy consumed in joules.*

Keywords: *Base station, Clusters, Cluster head, LEACH.*

1. INTRODUCTION

WSN (Wireless sensor network) is a part of WANETs (Wireless Ad hoc Networks). LEACH is a hierarchical cluster based routing protocol. LEACH is the most popular hierarchical cluster based routing protocol for a wireless sensor network. Every node makes use of a stochastic algorithm at each round to decide whether it will become a CH in the current round [1, 2]. LEACH assumes that each node has a radio powerful enough to directly reach the base station or the nearest cluster head, but making use of this radio at maximum power would be waste of energy. Nodes which have been CHs cannot become CH again for X rounds, where X refers to the desired percentage of CHs. Subsequently, each node has a probability of 1/X of becoming a CH again. At the end of each round, each node that is not a CH selects the closest CH and joins that cluster [3, 4]. The CH then come up with a schedule for each node in its cluster to transmit its data. All nodes that are not CHs only connect with the cluster head in a TDMA fashion, according to the schedule created by the CH. They do so using the minimum energy needed to reach the cluster head, and only need to keep their radios on during their time slot [5, 6, 7].

In LEACH, the nodes in the installed area are organized into local clusters and the communication process is divided into rounds with each round including set-up and steady-state phases [8, 9]. During the communication process, each cluster has a CH (cluster head) which is responsible for creating and manipulating a TDMA (time division multiple access) schedule table used by its member nodes to know when to transmit data packets [10, 11]. Once some emergency affairs happen in the monitor area, the sensor nodes are activated to send data to their own cluster head instead of the remote BS (base station) by themselves. The cluster head mainly collects the data coming from different member nodes and does some collection to diminish the redundancy firstly and then transmits them to BS. In the whole process, the cluster head just works as a relay node to help member nodes shorten the transmission distance so as to save energy [12, 13, 14].

2. CONTRIBUTION AND IMPLEMENTATION

The different scenarios have been discussed via assigning diverse values to the below mentioned parameters concerned with the implementation of LEACH protocol.

nn - Number of operating nodes

sz - Size of data package

nc - Number of clusters

nr - Number of rounds

en - Energy in joules

Case 1:

The parameters under study have been assigned below mentioned values.

nn - 100

sz - 1000

nc - 5

nr - 25544

en - 7200

Fig. 1 shows the randomly developed scenario with 100 nodes having coordinates of sink at (50, 50) shown in red color.

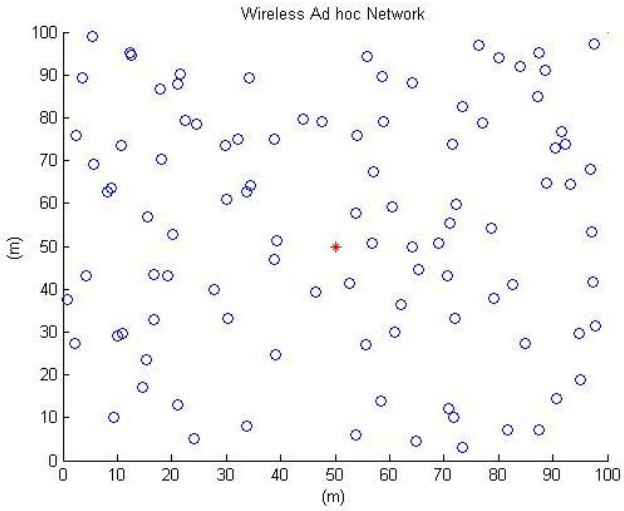

Figure1. *Figure shows the randomly developed setup with 100 nodes*

Fig. 2 shows the number of operating nodes per round under case 1.

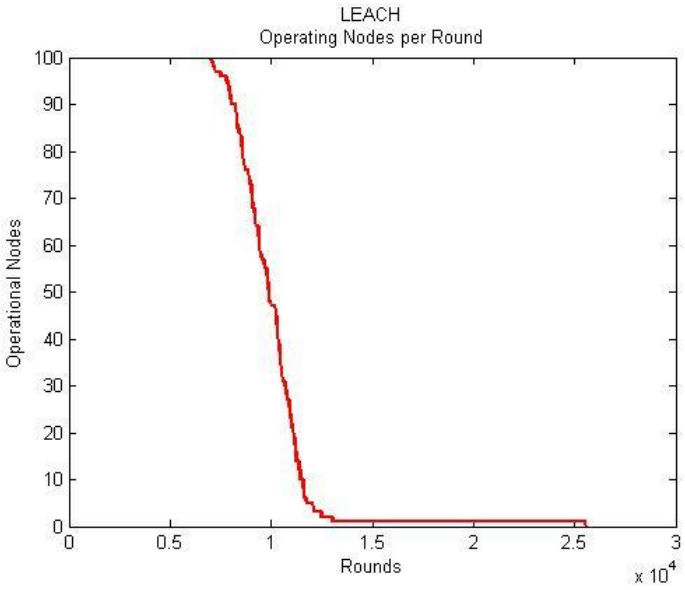

Figure2. *Figure shows the operating nodes per round under case 1*

Fig. 3 shows the number of operational nodes per transmission under case 1.

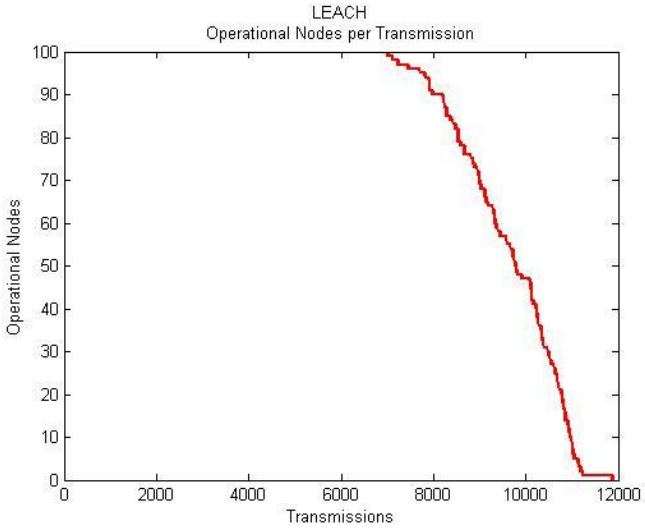

Figure3. *Figure shows the number of operational nodes per transmission under case 1*

Fig. 4 shows the amount of energy consumed per transmission under case 1.

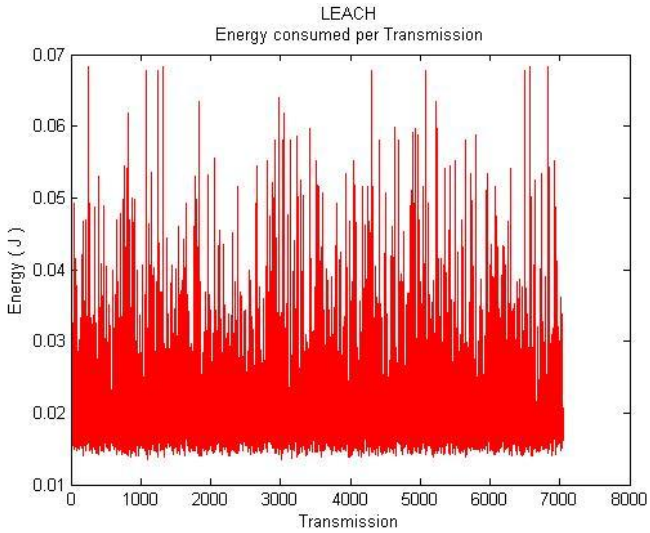

Figure4. *Figure shows the amount of energy consumed per transmission under case 1*

Fig. 5 shows the amount of average energy consumed by node per transmission under case 1.

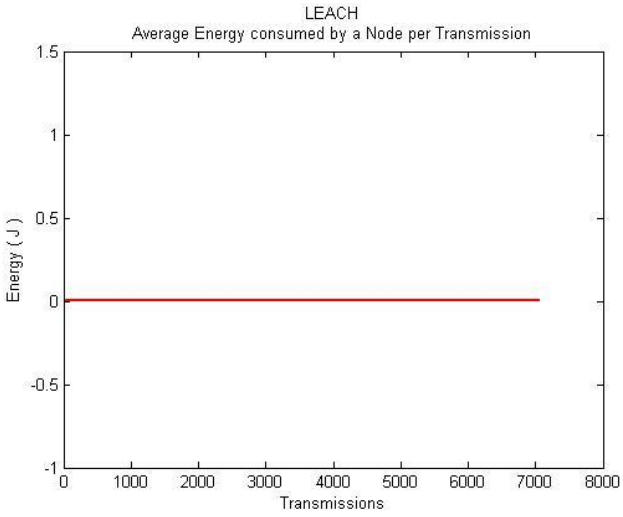

Figure5. *Figure shows the amount of average energy consumed by node per transmission under case 1*

Case 2:

The parameters under study have been assigned below mentioned values.

nn - 200

sz - 2000

nc - 10

nr - 11145

en - 1700

Fig. 6 shows the randomly developed scenario with 200 nodes having coordinates of sink at (70, 80) shown in red color.

Fig. 6 shows the number of operating nodes per round under case 2.

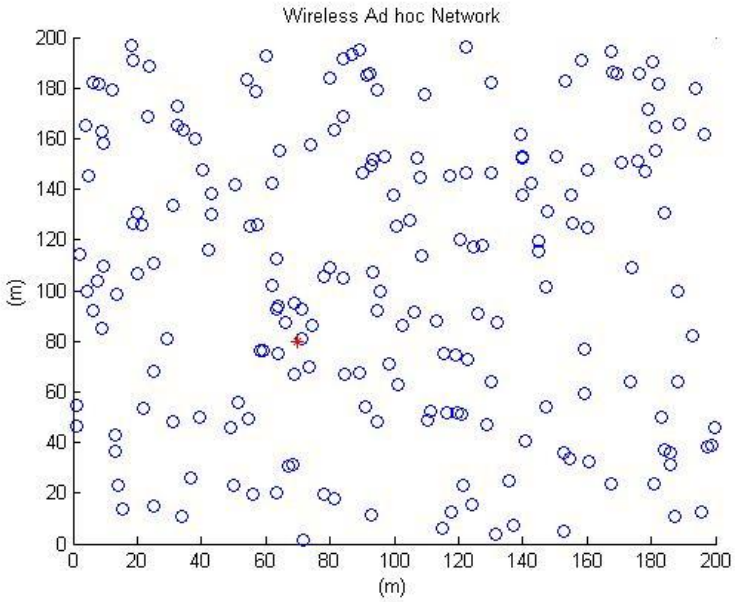

Figure6. *Figure shows the number of operating nodes per round under case 2*

Figure7. shows the number of operational nodes per round under case 2.

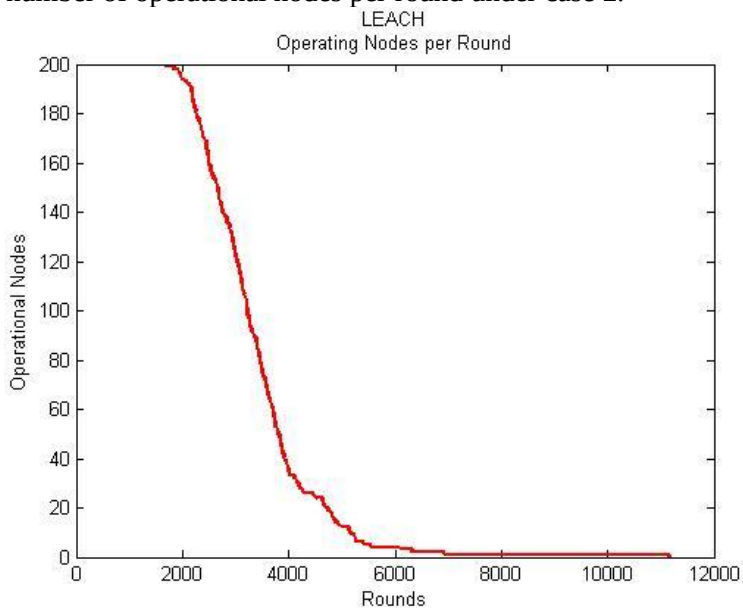

Figure7. *Figure shows the number of operational nodes per round under case 2*

Fig. 8 shows the number of operational nodes per transmission under case 2.

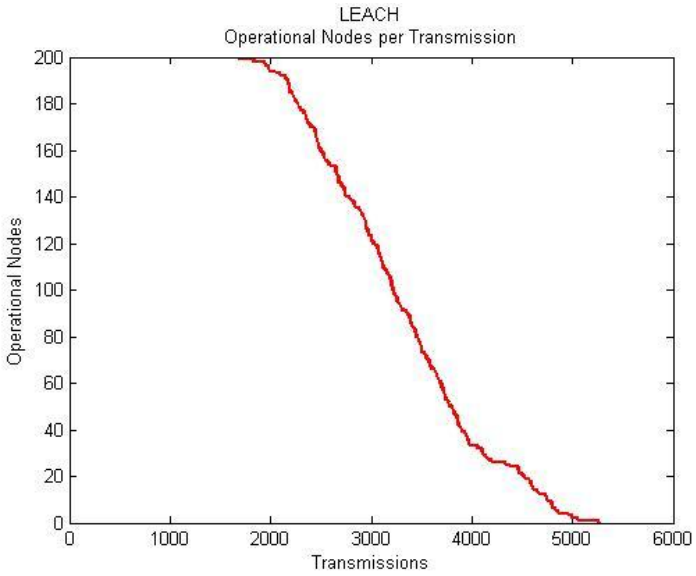

Figure8. *Figure shows the number of operational nodes per transmission under case 2*

Fig.9 shows the amount of energy consumed per transmission under case 2.

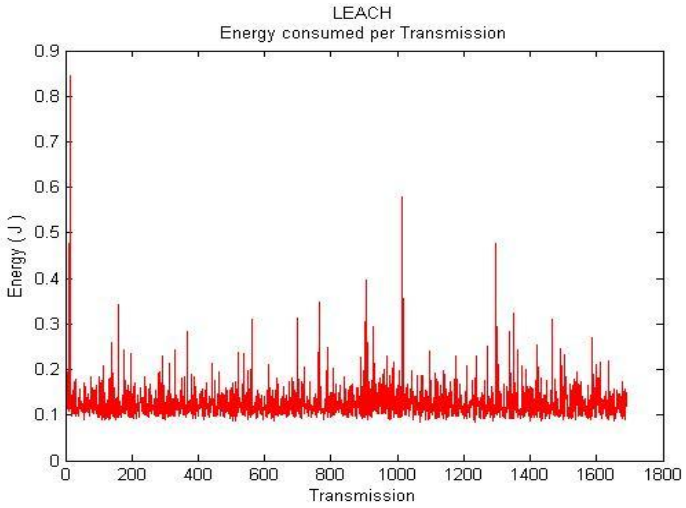

Figure9. *Figure shows the amount of energy consumed per transmission under case 2*

Fig.10 shows the amount of average energy consumed per transmission under case 2.

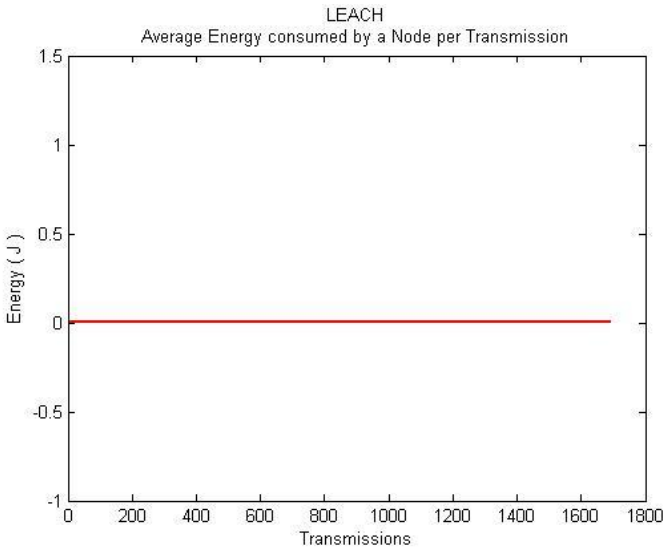

Figure10. *Figure shows the amount of average energy consumed per transmission under case 2*

Case 3:

The parameters under study have been assigned below mentioned values.

nn - 300

sz - 3000

nc - 15

nr - 5602

en - 650

Fig. 11 shows the randomly developed scenario with 300 nodes having coordinates of sink at (200, 200) shown in red color.

Fig. 11 shows the number of operating nodes per round under case 3.

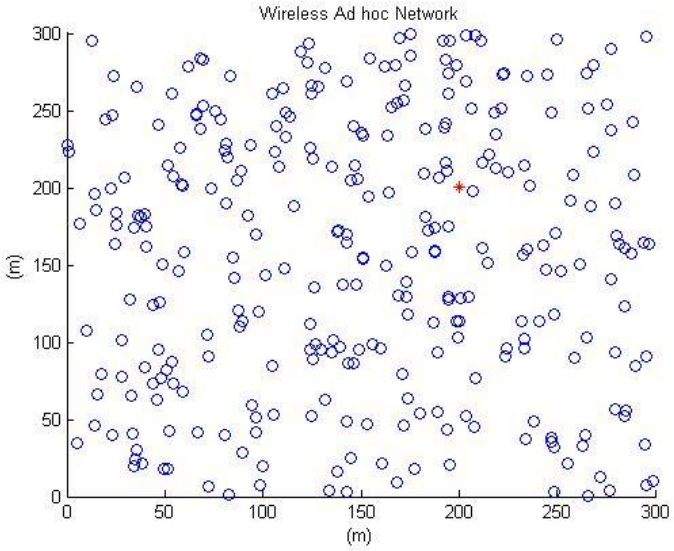

Figure11. *Figure shows the number of operating nodes per round under case 3*

Fig. 12 shows the number of operational nodes per round in case 3.

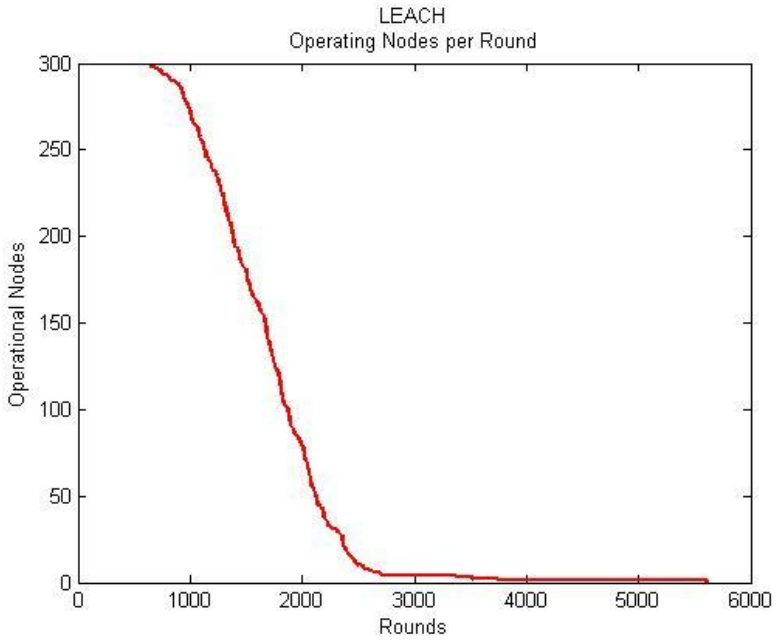

Figure12. *Figure shows the number of operational nodes per round in case 3*

Fig. 13 shows the number of operational nodes per transmission under case 3.

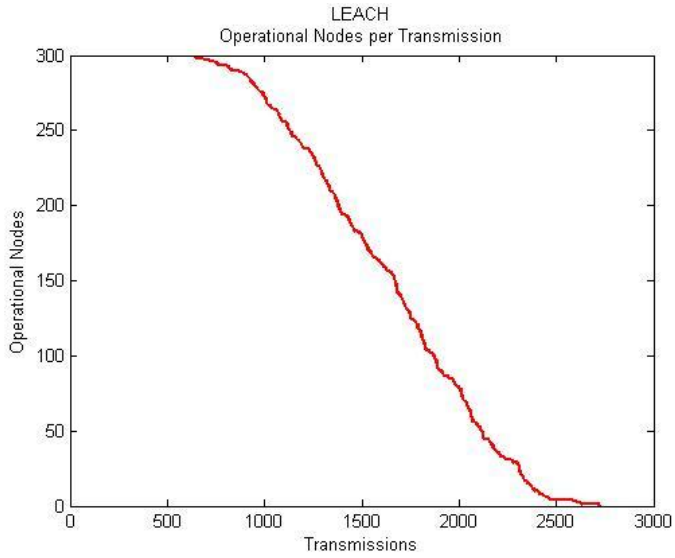

Figure13. *Figure shows the number of operational nodes per transmission under case 3*

Fig. 14 shows the amount of energy consumed per transmission under case 3.

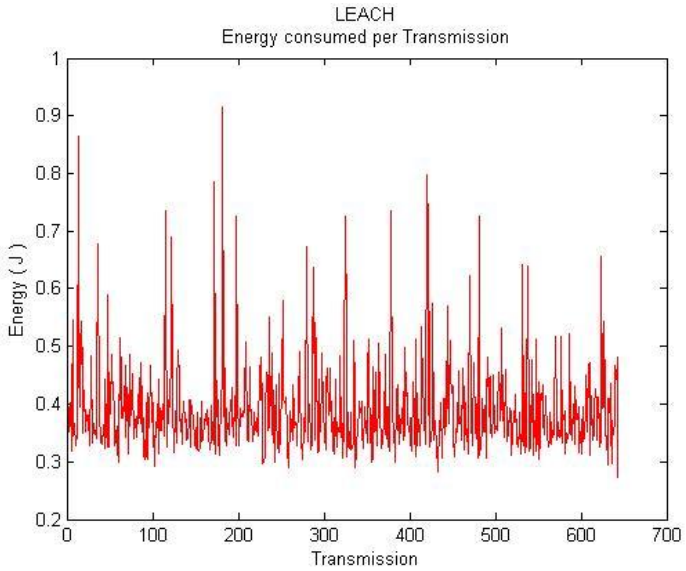

Figure14. *Figure shows the amount of energy consumed per transmission under case 3*

Fig. 15 shows the amount of average energy consumed by a node per transmission under case 3.

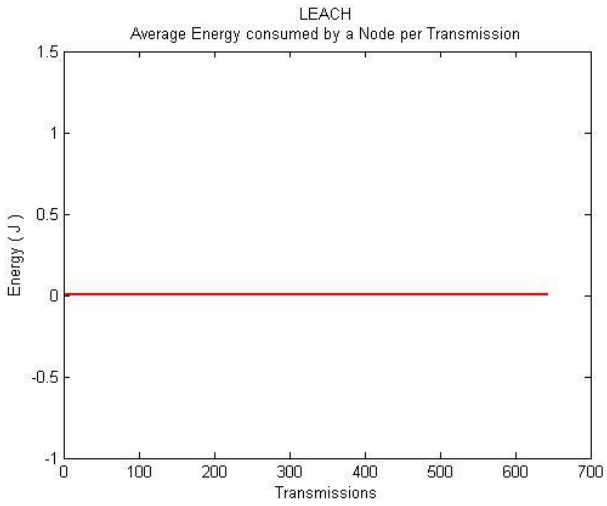

Figure15. *Figure shows the amount of average energy consumed by a node per transmission under case 3*

Case 4:

The parameters under study have been assigned below mentioned values.

nn - 400

sz - 4000

nc - 20

nr - 2367

en - 340

Fig. 16 shows the randomly developed scenario with 400 nodes having coordinates of sink at (200, 200) shown in red color.

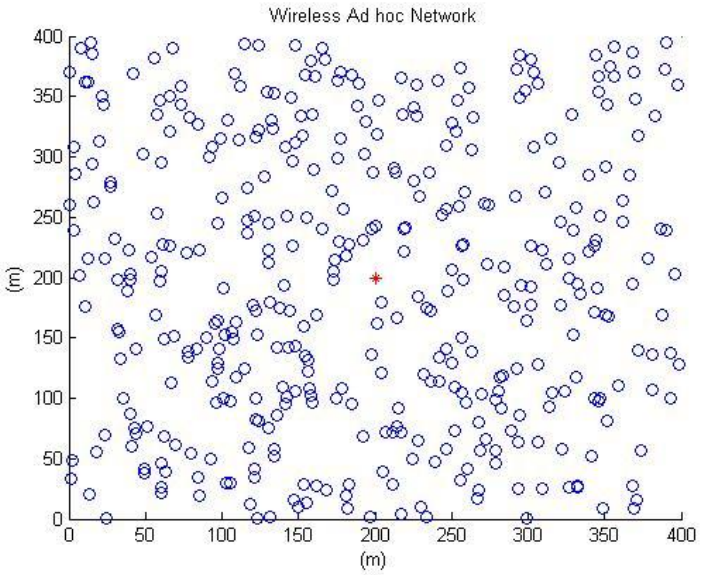

Figure16. *Figure shows the randomly developed scenario with 400 nodes having coordinates of sink at (200, 200) shown in red color*

Fig. 17 shows the number of operating nodes per round under case 4.

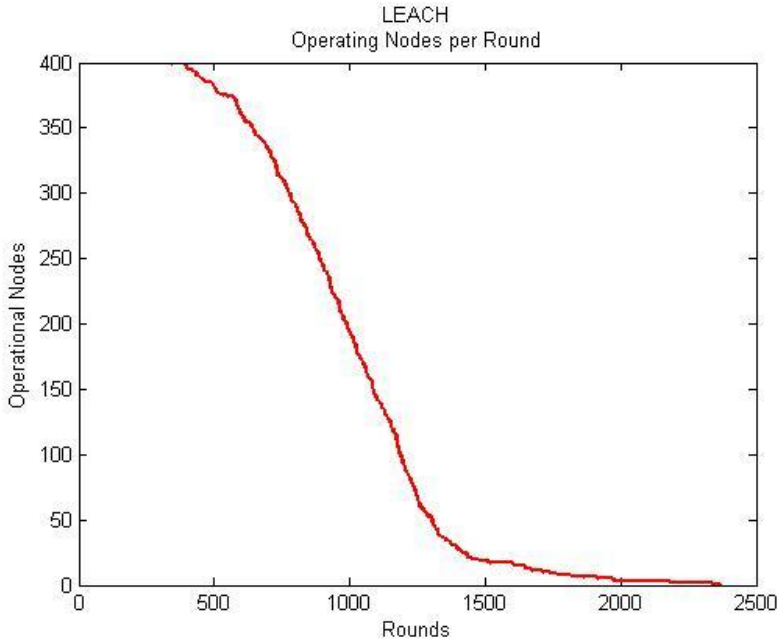

Figure17. *Figure shows the number of operating nodes per round under case 4*

Fig. 19 shows the number of operational odes per transmission under case 4.

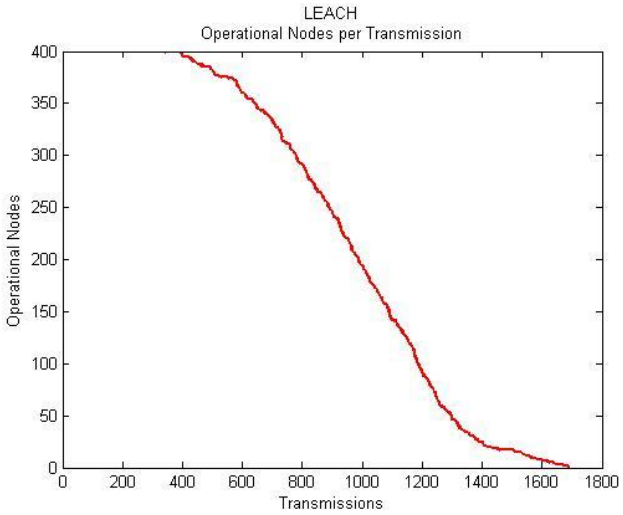

Figure18. *Figure shows the number of operational odes per transmission under case 4*

Fig. 19 shows the amount of energy consumed per transmission under case 4.

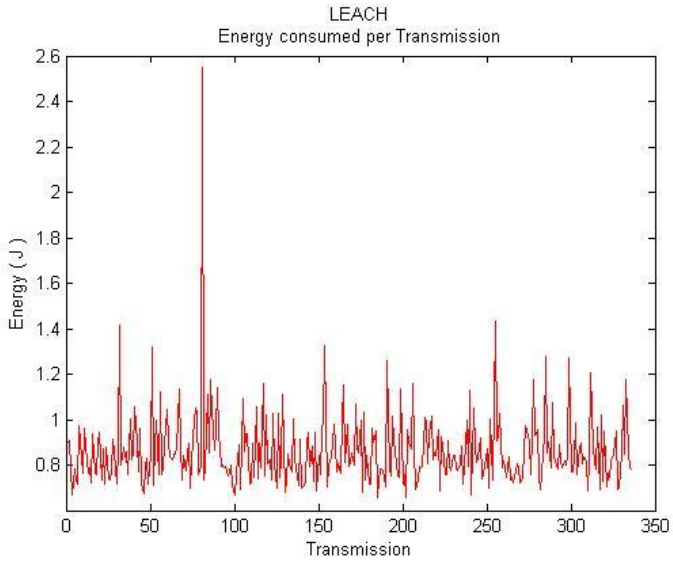

Figure19. *Figure shows the amount of energy consumed per transmission under case 4*

Fig. 20 shows the amount of energy consumed by a node per transmission under case 4.

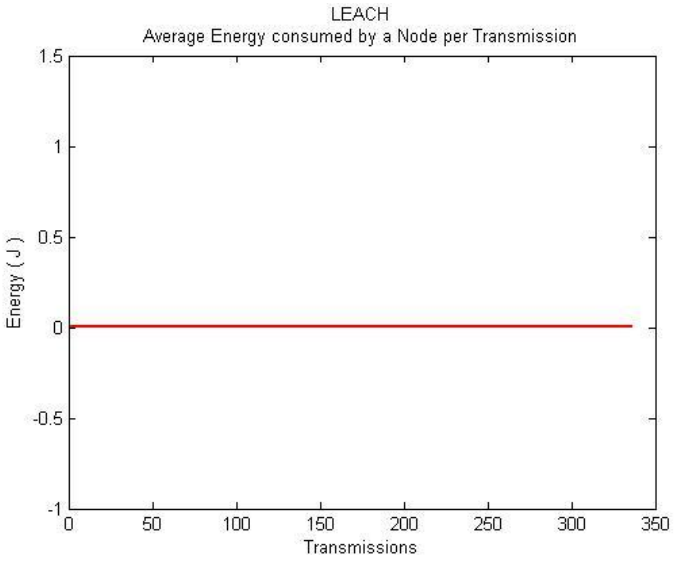

Figure20. *Figure shows the amount of energy consumed by a node per transmission under case 4*

Table 1 below shows the readings obtained on running different scenarios keeping initial dead nodes at 0 and percentage of cluster heads been static at 5%.

Table1. *Table shows the readings obtained on running different scenarios*

No. of operating nodes	Size of data package	Number of clusters	Number of rounds	Energy (Joules)
100	1000	5	25544	7200
200	2000	10	11145	1700
300	3000	15	5602	650
400	4000	20	2367	340

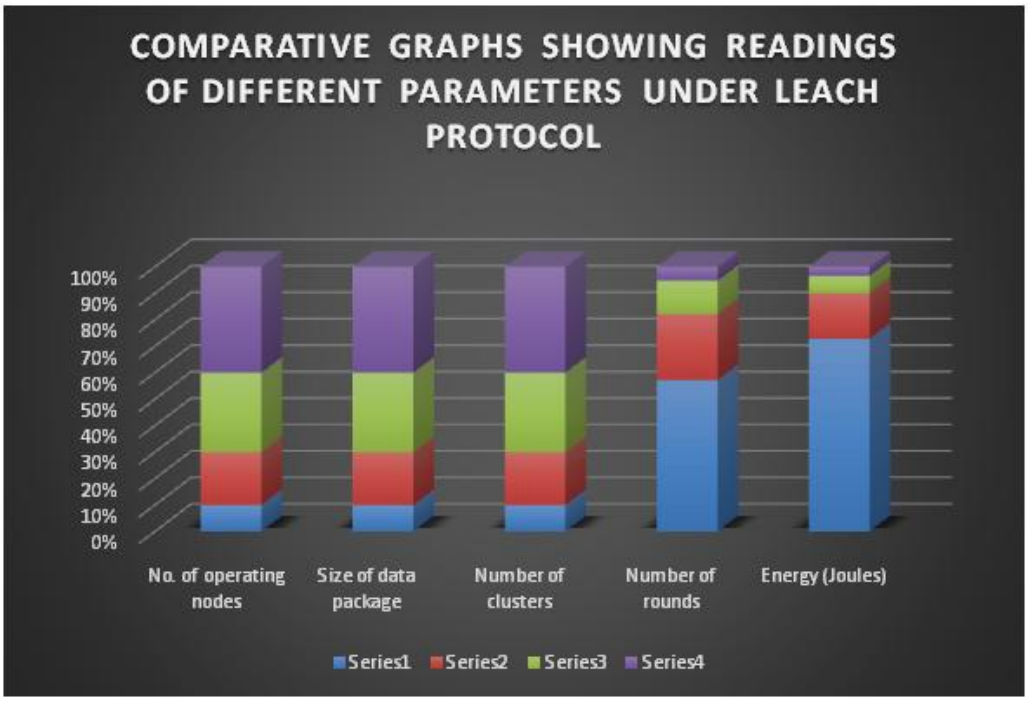

Figure22. *Figure shows the comparative readings obtained under different scenarios in graphical form*

3. CONCLUSION

The research paper discussed different scenarios implementing working of LEACH protocol. The readings obtained in above section shows that the number of rounds and energy consumption decreases with increase in number of operating nodes, size of data package, and number of clusters.

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