Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 03, March-2016

Simulation and Analysis of M-Gear Protocol Its comparison with LEACH Protocol

Dr. Rajesh Mishra
Head of Department, School of ICT
Gautam Buddha University
Greater Noida, India

Pritee Chaudhary,
School of ICT
Gautam Buddha University
Greater Noida, India

Manu Gangwar,
School of ICT
Gautam Buddha University
Greater Noida, India

Vandana Kumari Chalka,
School of ICT
Gautam Buddha University
Greater Noida, India

***Abstract*—In this research paper, we are comparing two protocols cognate to Wireless Sensor Networks, which are M-Gear (Gateway-Based Energy Efficient Multi-Hop Routing Protocol for WSNs) and LEACH(Low-Energy Adaptive Clustering Hierarchy Protocol). Both of these two protocols are designed by aiming minimum energy consumption while providing maximum throughput and keeping maximum number of nodes alive for a longer duration. We are utilizing MATLAB implementation for the simulation and taking homogeneous conditions for both the protocols and then we are observing the performance of both the protocols depending on the graphs which are obtained afterwards. Additionally, as per the M-Gear protocol, we are dividing the area of the network into four components for the transmission of the message signals. The region in the network is divided according to the distance of the node from the base-station and the gateway, and the nodes follow the different methods of transmission accordingly.**

Keywords—Protocol, Cluster, Gateway, Cluster-Head, Nodes.

INTRODUCTION

Wireless Sensor Networks are densely deployed networks utilized in industrial, medicinal, automation, research applications. The network is not perpetual and is dynamic. Additionally, the nodes of the Sensor Network are not facilely chargeable. So, there is a prodigious research work going on in the field of Wireless Sensor Network.

The Wireless Sensor Networks are characterized into homogeneous and heterogeneous networks. The homogeneous networks are the one whose nodes have equal energy and the heterogeneous networks are the one whose nodes have unequal energy initially.

Here, the heterogeneous networks can be two-level or multi-level. Additionally, the protocols designed for sensor networks are withal characterized by homogeneous and heterogeneous networks depending upon the application and requisites.

In [2], Heinzelman et.al. presented an energy-efficient communication protocol for Wireless Microsensor Networks, designated as LEACH. Microsensor Networks have a prodigious use for keeping an authentic check-on in a disastrous, deserted or army areas. LEACH (Low-Energy Adaptive Clustering Hierarchy) protocol is a homogeneous network protocol. Afore LEACH, there were protocols which used multi-hop routing, direct transmission of data, and a fine-tuned cluster formation, which later on were found to be unsuitable for Wireless Sensor Networks. In LEACH, the cluster heads are assigned depending upon the cluster formation and the energy is additionally equi-potentially allotted to the network nodes. This protocol uses sectional synchronization for the reconciliation and the validity of the active networks, and additionally accomplishes the aggregation of data to minimize the information that has to be transmitted to the base station. This was utilizable for the homogeneous energy utilization throughout the network. LEACH amended the transmission capacity by 8 times in comparison to the earlier protocols.

In [9], Lindsey et.al. described PEGASIS (Power Efficient Gathering in Sensor Information Systems), a link predicated protocol. In this protocol, every individual node interacts only with a proximate neighbor and transmits to the base station turn sapient, thus minimizing the energy spent per round. The performance of PEGASIS was better than LEACH by about 100% to 300% for different topologies of the network. But the sequence formation of nodes required the ecumenical information of the nodes, thus making it onerous to utilize it. Additionally, these two protocols i.e. LEACH and PEGASIS were good for homogeneous networks only, and not for heterogeneous networks. So, the later works focused the heterogeneous networks.

In [10], Osama Younis and Sonia Fahny presented a heterogeneous network protocol called HEED (Hybrid Energy-Efficient Distributed Clustering) in which the cluster heads are sporadically culled predicated on the composite characteristic of nodes' residual energy and an another parameter like node location to its neighbors or its degree. In this the network was postulated to be quasi-stationary in which the nodes are position independent and have equal paramountcy. HEED ceases in O(1) repetitions, not depending upon the network size, obtain minute message overhead, and gets equalized homogeneous cluster head arrangement over the network.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 03, March-2016

A key feature was that it utilized the opportunity of several power levels at sensor nodes. HEED was able to elongate the network lifetime, HEED the network lifetime. HEED parameters like the minimum cull probability and network operation interval, can be smoothly tuned to modify resource consumption in accordance to the network frequency and utilization.

I. M-GEAR PROTOCOL

In Wireless Sensor Networks, direct transmission of data packets from sensor nodes to the base station is very uneconomical as it costs a lot of energy consumption. This can be improved by the aggregation of data packets from all sensor nodes at a single node called the gateway node which can be placed at the centre of the network and this gateway node can be used for transmitting the aggregating data signals to the sink node located outside the network or far away from the network. This gateway node can be rechargeable so that there will be less burden of being energy efficient, as the expenses for recharging a gateway node are much less than the replacement of a sensor node. Also, the data transmitted from the sensor nodes can be collected at the cluster heads before being transmitted to the gateway node, again improving the energy efficiency of the network.

At the initial phase of the protocol, the sink node or the base station sends some beacon packets to all the sensor nodes which are homogeneously distributed in the network and these individual sensor nodes give response signals to the base station. The base station thus calculates and stores the node ID, their residual energy and each sensor node's distance from the base station and the gateway node.

After that the network is divided into different sections. The nodes which are near to the sink node send their data directly to the sink node. The nodes which are near to the gateway nodes send their data signals to the gateway node directly. And the third type of nodes which are neither close to the sink node nor to the gateway node form clusters and they send their data to their respective cluster heads. These cluster heads then transmit the data to the gateway node where that is aggregated and afterwards is transmitted to the sink node.

Cluster heads are selected depending upon the residual energy of the nodes and autonomously chosen random no. The no. of rounds equal to the no. of nodes in the network is called as an epoch. Each node is chosen as the cluster head once in an epoch. Every individual node selects a random no. between 0 and 1 and is composed to a pre-defined threshold value and if it is more than that threshold value, then it is elected as the cluster-head, otherwise not. The nodes which have not been the cluster-head in last rounds are more likely to be the cluster head. After forming the cluster heads, these cluster head nodes send signals to all neighboring nodes so as to inform about their presence, location and role. The nodes become the member of that cluster whose cluster head is nearest to that node.

After this, the cluster heads do the TDMA scheduling for their cluster nodes. They allot particular time slots to their cluster nodes to transmit the data to their cluster heads. The cluster nodes will transmit the data to their cluster heads in their allotted time slots only, at other time they will go to sleep mode and will remain idle. The cluster heads will collect the data and transmit it to the gateway node for the aggregation. From the gateway node, the data will be transmitted to the sink node.

II. LEACH-PROTOCOL

LEACH is a very famous protocol utilized in Wireless Sensor Networks. The working of LEACH protocol in the network takes place by going through different phases. Initially, all the nodes in the network are given equal amounts of initial energy. Then some nodes are arbitrarily culled as the cluster heads uniformly distributed in the network. Then these cluster heads start sending advertising signals to their neighboring nodes. The other nodes, which are not the cluster heads, receive these signals and send the replication signals. All this takes place through the CSMA protocol, and this phase is called as "cluster-head-advertisement" phase.

The neighboring nodes compares the advertisement signals from different cluster heads and send the replication-signals to the cluster-head from which it is receiving the most vigorous signals and in this way the most proximate cluster heads are culled. Thus the nodes cull their cluster-heads and become the component of the cluster of the respective cluster-head. This phase is called as the cluster set-up phase.

After this, the cluster heads assign certain time slots to their cluster nodes to transmit the signals utilizing TDMA (Time Division Multiple Access). Thus the cluster nodes keep slumbering except their respective time slots in which they send the information signals to their cluster heads, thus reducing the energy consumption. Only the cluster heads keep on working all the time and just a few of other cluster nodes are sending the data. After all the nodes have sent their data, the cluster head aggregates the consummate data to reduce the amount to be transmitted to the sink or the base station, thus again reducing the amount of energy consumption.

Once this process gets over, the next round takes place and some other nodes are assigned the cluster-heads which are having more energy in comparison to the nodes which were assigned to be the cluster heads in some antecedent rounds, thus making all the nodes to be the cluster heads in a no. of rounds and ergo, balancing and maintaining the uniformity of energy dissipation among all the nodes in the network, and hence amending the network lifetime.

RESULTS

We simulated the given M-Gear protocol given by Nadeem et.al. and the LEACH protocol given by Heinzelman in MATLAB. The network scenario is considered to be 100mx100m, with 100 nodes in the network. Also, the gateway node is considered to be at the centre of the network area and the sink node is considered to be at the mid-point of the x-coordinate and outside the network area. Also, the initial energy of each node was taken to be 0.5J, thus 100x0.5=50J to be the energy of the whole network. The receiver electronics energy is considered to be 5nJ/bit, free space loss energy to be 10pJ/bit/m^2, multipath loss energy

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 03, March-2016

0.0013pJ/bit/m^4, and data aggregation energy to be 4000 bits. The maximum no. of rounds was taken to be 3000.

We have optimized and compared the M-GEAR protocol with the LEACH protocol and have taken four graphs.

In fig1, the percentage of alive nodes is plotted against the no. of rounds. In this, we can see that the percentage of alive nodes start falling after 1000 rounds and falls almost to zero after around 1500 rounds in LEACH whereas it was after around 2500 rounds in M-GEAR.

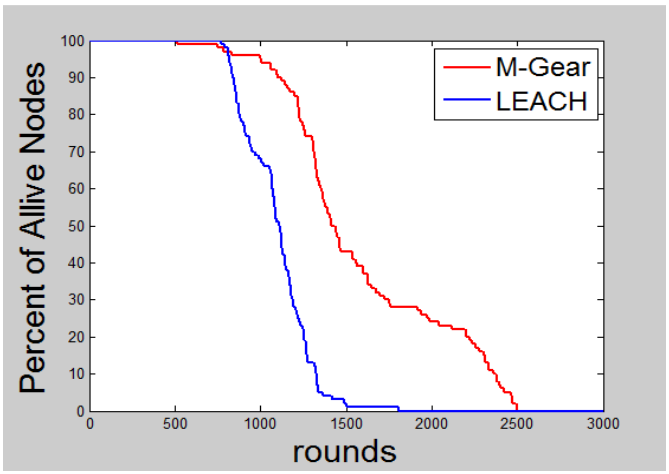

Fig. 1. Percent of Allive nodes vs. the no. of rounds in the network.

In fig.2, the number of dead nodes is plotted against the no. of rounds. The node is considered dead when its residual energy is 0. Here we can also see, that the no. of dead nodes becomes 100 i.e. all node dies at after around 1500 rounds in LEACH and at after around 2500 rounds in M-GEAR.

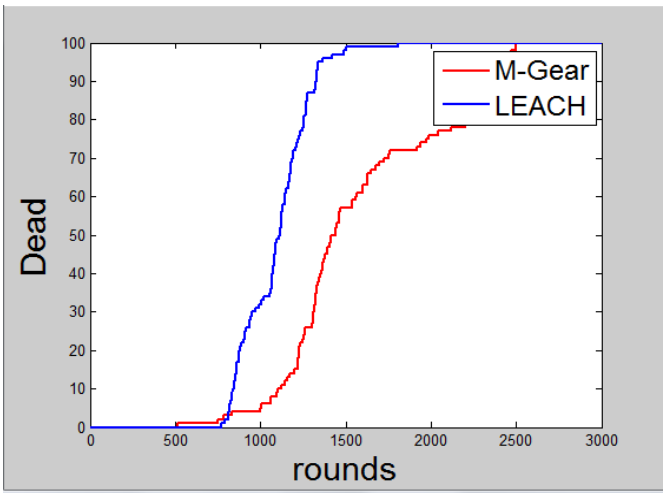

Fig. 2. Percent of Dead nodes vs. the no. of rounds in the network.

In fig.3, we can see that the no. of packets delivered becomes constant, i.e. no more packets are transmitted after about 1500 rounds in LEACH whereas it keeps on increasing till 2500 rounds in M-GEAR.

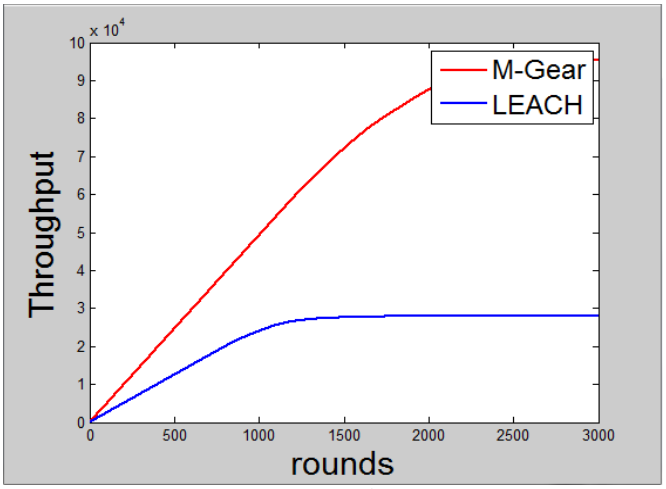

Fig. 3. Throughput vs. the no. of rounds in the network.

In fig.3, the throughput is shown in terms of no. of packets transmitted whereas in fig.4, the throughput is shown considering the no. of nodes that can transmit the packets. Here, we can see that in LEACH, till 1000 rounds, almost all nodes can transmit and after that the no. of nodes transmitting start decreasing significantly after around 1500 nodes and it becomes 0 at 1500 rounds in LEACH and at after 2500 rounds in M-GEAR.

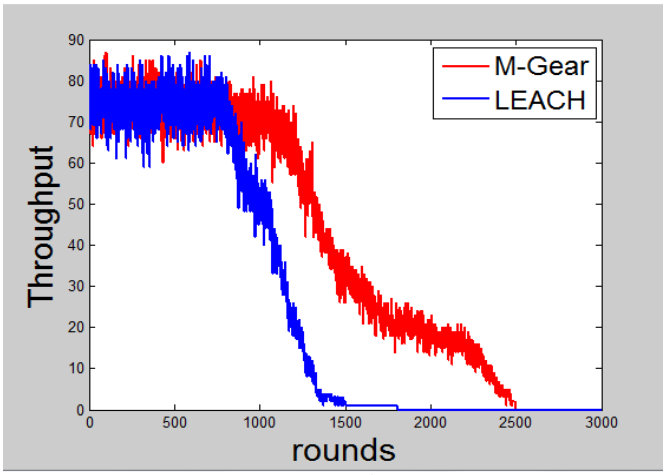

Fig. 4. Throughput vs. the no. of rounds in the network.

ACKNOWLEDGMENT

We thank the almighty God and our parents without whose blessings and motivation this work would not be accomplished

CONCLUSIONS

In this work, we took two networks with same no. of nodes in the network. Additionally, the region of the network and signal transmission is additionally taken to be homogeneous. Then, in one network, the transmission is done by applying LEACH protocol and the results for the comparison are obtained simultaneously. The total no. of nodes was taken to be 100 and the area of the network was taken to be 10mx10m. The initial energy of the nodes was additionally fine-tuned and withal the overall initial energy of the network was additionally fine-tuned. Gradually, with the transmission, the energy of the nodes and thus additionally of the network

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 03, March-2016

kept reducing. When the energy of any individual node reduces to or below a cut off energy level, then the node was called to be dead node and thus, when the overall energy of the network was reduced as a result of the majority or all nodes becoming dead node, the network was additionally called to be dead. The time taken to take place this is referred to as the lifetime of the network and it is better to have a longer lifetime. In other words, lesser dead nodes in the network. From the graphs that we have achieved, we can analyze that the performance of the M-Gear protocol is far much better than the LEACH Protocol in terms of the network lifetime as well as the throughput of the network. Throughput is the amount of data transferred by a network.

REFERENCES

[1] Q. Nadeem, M.B. Rasheed, N. Javaid, Z.A. Khan, Y. Maqsood and A. Din, "M-GEAR Gateway-Based Energy-Aware Routing Protocol for WSNs," IEEE Conference, Compiegne, 10.1109/BWCCA.2013.35, 28-30 Oct. 2013.

[2] Wendi Rabiner Heinzelman, Anantha Chandrakasan, and Hari Balakrishnan, "Energy-Efficient Communication Protocol for Wireless Microsensor Networks," IEEE System Sciences, 2000. Proceedings of the 33rd Annual Hawaii International Conference, 4-7 Jan. 2000.

[3] Tahir, M., et al., "On Addaptive Energy-Efficient Transmission in WSNs," International Journal of Distribued Sensor Networks 2013(2013).

[4] B. Manzoor, N. Javaid, O. Rehman, M. Akbar, Q. Nadeem, A. Iqbal, M. Ishfaq, "Q-LEACH: A New Routing Protocol for WSN", Internat ional Workshop on Body Area Sensor Networks(BASNet-2013) in conjunc- tion with 4th International Conference on Ambient Systems, Networks and Technologies (ANT 2013), 2013, Halifax, Nova Scotia, Canada, Procedia Computer Science, Volume 19, 2013, Pages 926-931, ISSN 1877-0509.

[5] K. Latif, A. Ahmad, N. Javaid, Z. A. Khan and N. Alrajeh, " Divide-and-RuleScheme for Energy Efficient Routing in Wireless Sen sor Networks", The 4th International Conference on Ambient Sys tems, Networks and Technologies (ANT 2013), 2013, Halifax, Nova Scotia, Canada, Procedia Computer Science, Volume 19, 2013, Pages 340-347, ISSN 1877-0509,http://dx.doi.org/10.1016/j.procs.2013.06.047. Proce- dia Computer Science.

[6] N. Javaid, M. Waseem, Z. A. Khan, U. Qasim, K. Latif and A. Javaid, "ACH: Away Cluster Heads Scheme for Energy Efficient Cluster ing Protocols in WSNs", 2nd IEEE Saudi International Electroni cs, Commu- nications and Photonics Conference (SIECPC 13), 2013, Riyadh, Saudi Arabia.

[7] Jafri, Mohsin Raza, Nadeem Javaid, Akmal Javaid, and Zahoor Ali Khan. "Maximizing the Lifetime of Multi-Chain PEGASIS Usin g Sink Mobility." World Applied Sciences Journal 21, no. 9 (2013): 1283-1289.

[8] M. Akbar, N. Javaid, A. A. Khan, Z. A. Khan, U. Qasim, "On Modeling Geometric Joint Sink Mobility with Delay-tolerantCluster-less Wireless Sensor Networks", 4th IEEE Technically Co-Sponsored International Conference on Smart Communications in Network Tech-nologies (SaCoNet'13) 2013, Paris, France.

[9] Lindsey, Stephanie, and Cauligi S. Raghavendra. "PEGAS IS: Power-efficient gathering in sensor information systems." Aerosp ace conference proceedings, 2002. IEEE. Vol. 3. IEEE, 2002.

[10] Younis, Ossama, and Sonia Fahmy. "HEED: a hybrid, energy - efficient,distributed clustering approach for ad hoc sensor networks." Mobile Computing, IEEE Transactions on 3.4 (2004): 366-379.