International Journal of Advanced Trends in Computer Applications
www.ijatca.com

# Performance Evaluation of QOS Parameters in WSN Using GA

**[1]Moninder kaur, [2]Daljeet Singh Bajwa**
[1]M.tech Scholar
ECE Department
Baba Banda Singh Bahadur Engineering College
Fatehgarh Sahib Punjab
[2]Assistant Professor
ECE Department
Baba Banda Singh Bahadur Engineering College
Fatehgarh Sahib Punjab
*Moninder90@yahoo.com, daljeet.singh@bbsbec.ac.in*

**Abstract:** *Many protocols have been proposed in order to minimize the energy consumption of WSN nodes. But the genetic algorithms are unconventional explore and optimization algorithms, which impersonate several of the processes of neural evolution. GAs performs aimed at chance searches during an agreed set of alternatives with the aim of judgment the best option with respect to the known criterion of goodness. These criteria are necessary to be uttered in terms of an aim function which is frequently referred as objective Function. Also Low Energy Adaptive Clustering Hierarchy is the first energy capable routing protocol for hierarchical clustering. It decreases the energy considerably. The leach protocol forms clusters in the sensor networks and by chance selects the Cluster-heads for each cluster. Non cluster-head nodes sense the data and put out to the cluster-heads. The cluster-heads cumulative the established data and then onward the information to the sink. The main goal of this thesis is to improve the energy consumption rate. In this paper, objective function are applied in genetic algorithm to calculate the average energy of the arrangement and to make sure which block has lesser energy than average energy. The whole simulation is taken place in the MATLAB 7.10 background. The planned technique is providing the promising results.*

**Keywords:** *Energy Optimization, WSN, LEACH Protocol, Constraints, Genetic Algorithm.*

## I. INTRODUCTION

Wireless sensor networks (WSNs) consist of a large number of tiny, cheap, computational, and energy-constrained sensor nodes that are deployed in network service area and since it's nature is wireless , it is easy to add more sensor nodes or move deployed/mounted nodes for better coverage and reach.

Recent advances in wireless communications and electronics have enabled the development of low-cost, low-power, multifunctional sensor nodes that are small in size and communicate undeterred in short distances.

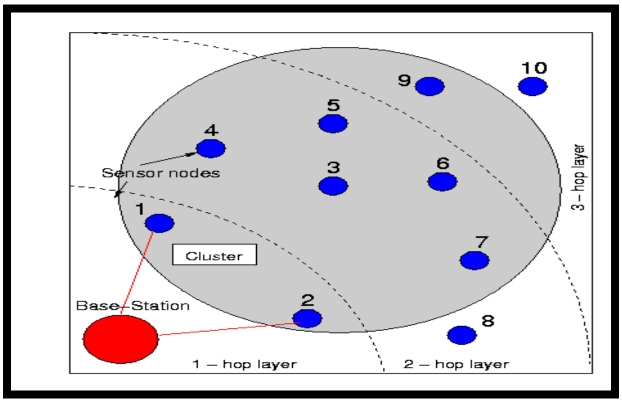


**Figure. 1.** Collection of networked sensors

Wireless Sensor Network is a class of wireless ad- hoc networks which consists of spatially distributed autonomous sensor nodes to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. at different locations. Energy consumption is the core issue in wireless sensor networks because nodes are battery operated. It is desirable to make these nodes as cheap and energy-efficient as possible and rely on their large numbers to obtain high quality results.

Researchers in the area have proposed several different approaches to optimizations of a wireless sensor network design [2]. To meet different design criteria, related researches into optimization of wireless sensor network design can be grouped into three categories: optimization in the communication layers, node hardware optimization and cross-layer optimization. However, most of the optimization procedures do not take into account the principles, characteristics and requirements of an application-specific WSN at the system level. So in this proposed work energy optimization will be done using Genetic Algorithm in LEACH protocol [3].

# II. ENERGY CONSUMPTION

*2.1 Theoretical background*

*Radio model:* The radio model is showed in Figure.2

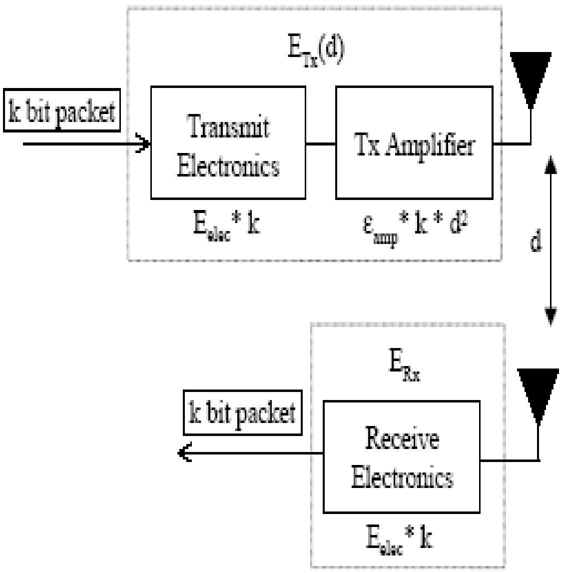


**Figure.2** Radio model for WSN

The formula for sending and receiving a message:

$$E_{Tx}(k,d) = E_{Tx-elec}(k) + E_{Tx-amp}(k,d)$$
$$E_{Tx}(k,d) = E_{elec} * k + \epsilon_{amp} * k * d^2$$

Energy consumption formula for sending a k-bit message to a distance *d:*

$$E_{Rx}(k) = E_{Rx-elec}(k)$$
$$E_{Rx}(k) = E_{elec} * k$$

Where Tx= transmitter energy, Rx is Processor energy. Eelec is energy of electrodes, amp is amplifier energy, k & d are variables.

# III. LEACH ENEERGY CONSUMPTION MODEL

Low Energy Adaptive Clustering Hierarchy (LEACH) is the first hierarchical cluster-based routing protocol for wireless sensor network which divides the nodes into clusters, in each cluster a devoted node with additional privileges called Cluster Head (CH) is accountable for creating and manipulating a TDMA (Time division multiple access) calendar and sending collective data from nodes to the BS where these data is required using CDMA (Code division multiple access). Remaining nodes are cluster members. This protocol is separated into rounds; every round consists of two phases [26];

**Set-up Phase**

(1) Advertisement Phase

(2) Cluster Set-up Phase

**Steady Phase**

(1) Schedule Creation

(2) Data Transmission

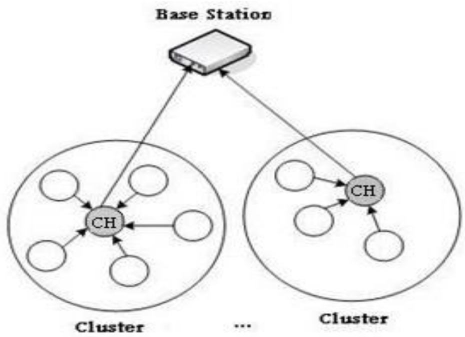


**Figure.3** LEACH Protocol [4]

### 3.1 Implementation Assumptions of LEACH Algorithm

The nodes have initial uniform energy, of 0.5joules.

- Each sensor node initially has the ability to transmit data to any other sensor node or directly to BS.
- The sensor nodes are stationary.
- Packet size is the same for all nodes, with a minimum packet size of 2000kbit.
- Nodes have unique IDs.
- A node belongs to only one cluster, but may change its cluster affiliation during each round.
- It was assumed that the sensor node are scattered all over the field [27].

***Properties Of This Algorithm Include***

- Cluster based
- Random cluster head selection each round with rotation. Or cluster head selection based on sensor having highest energy
- Cluster membership adaptive
- Data aggregation at cluster head
- Cluster head communicate directly with sink or user
- Communication done with cluster head via TDMA
- Threshold value

# IV. ENERGY OPTIMIZATION ALGORITHM USING GENETIC ALGORITHM

Below figure displays the working for optimization of energy using GA.

- Initialise No. of nodes
- Initialise length
- Initialise Width
- Assume pre-defined energy
- Get number of nodes in the box.
- Take random energy value
- Plot X and Y location
- Calculate energy of each block
- Define source node
- Find failed Block
- Checking whether the source block and the failed block are similar or not.
- Find Destination Block.
- checking that the destination node is not equal to the source node and the failed node
- if yes then des =1
- this identifies that the source block and the failed block are not similar
- Cluster Head Fails
- Call GA
- Find final route through which the data will travel
- check if the node is not similar
- applying the second condition where energy is also a constraint
- Optimize Qos parameters using objective function
- Plot Qos parameters

# V. SIMULATION MODEL

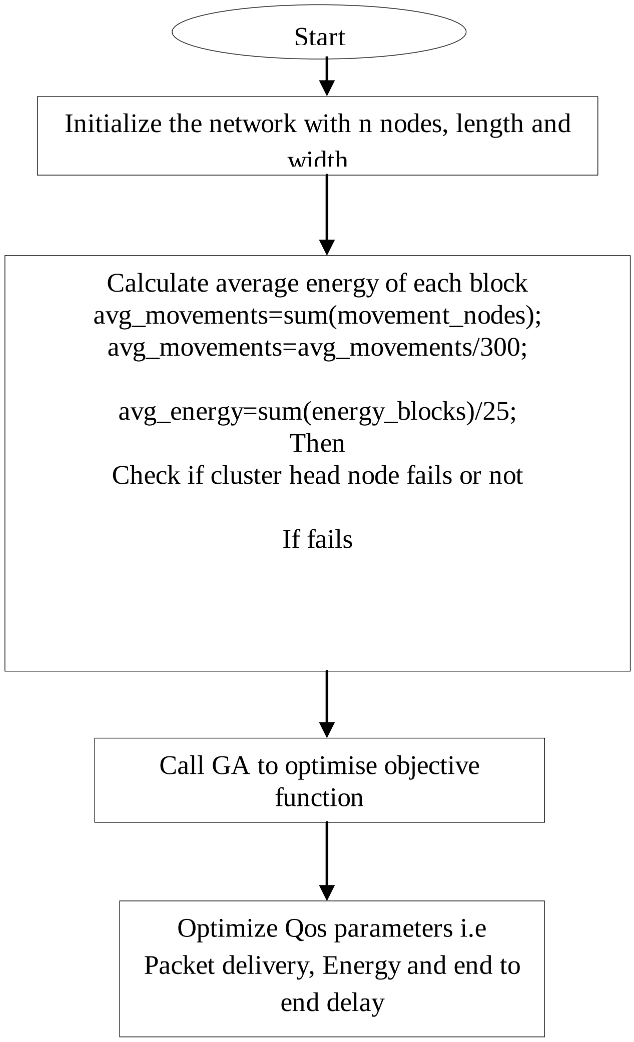


**Figure.4** Proposed Flowchart

Above figure shows the step by step process of energy optimization.

# VI. RESULTS AND IMPLEMENTATION

The whole simulation has been done using GA in MATLAB 7.10 environment.

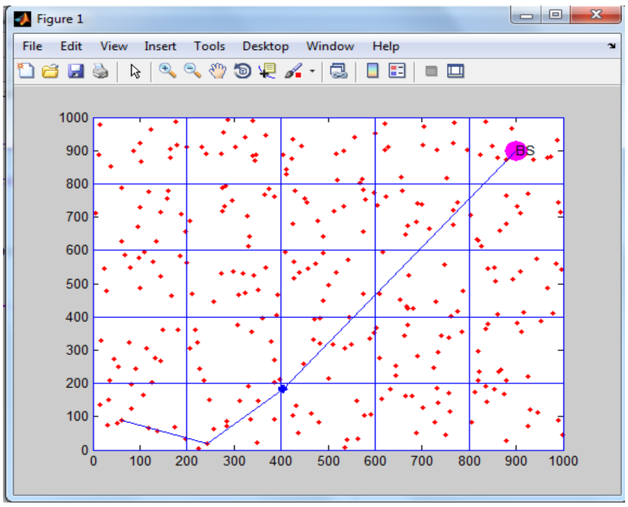


**Figure.5** Network Deployment

Above figure shows node deployment 1000* 1000 Length and width. Pink Dot describes the Base Station node. Red dot describes the source node.

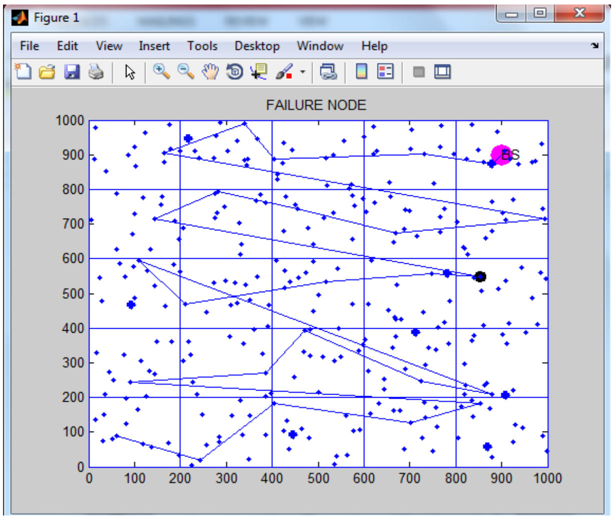


**Figure.6** Failure Node

Above figure describes the node failure process. If the node failure occurs then probability of network degradation occurs high. In the next steps diagnosis of node failure.

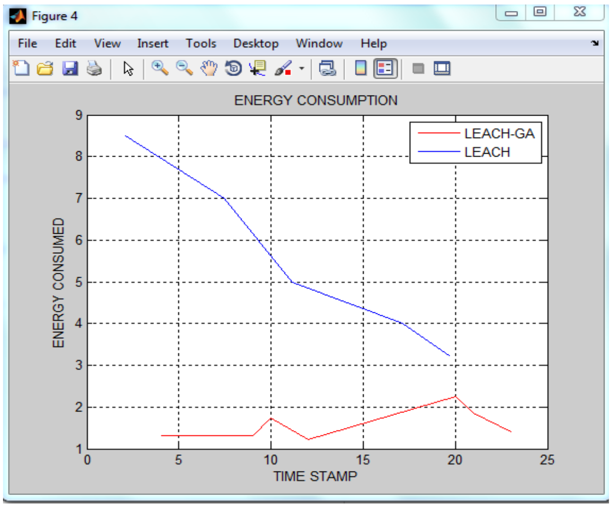


**Figure.7** Energy Consumption

In above figure it shows graph plotted in between time stamp and energy consumed by the nodes after utilizing GA and without GA algorithm. It has been clearly seen that energy consumption for LEACH-GA is less in accordance with LEACH only. Energy consumption has been calculated as:

energy_consumed1

(i)=energy_per_block(path(i))+extra_error_energy(path(i))

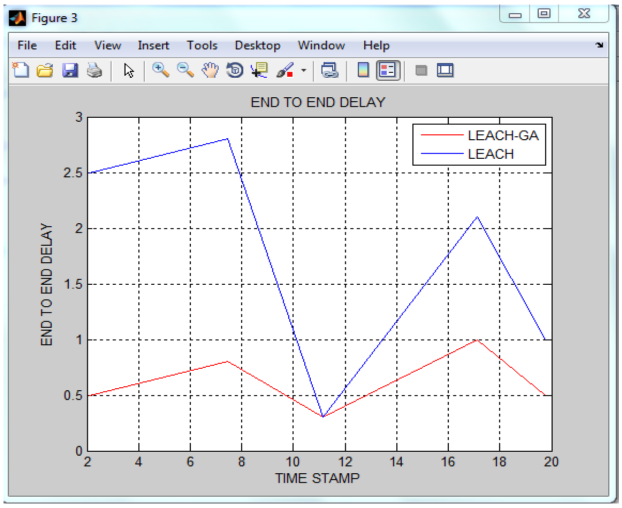


**Figure.8** End to End Delay

As above figure shows graph plotted between end delay and time stamp on which end delay occur. End to End Delay signifies the total amount of time taken by a packet from source to destination. According to above diagram end delay for LEACH-GA is less in comparison to LEACH only. End to end delay has been measured using following:

end_delay(w)=(((n_clusters-2)/time_stamp(w)))/100;

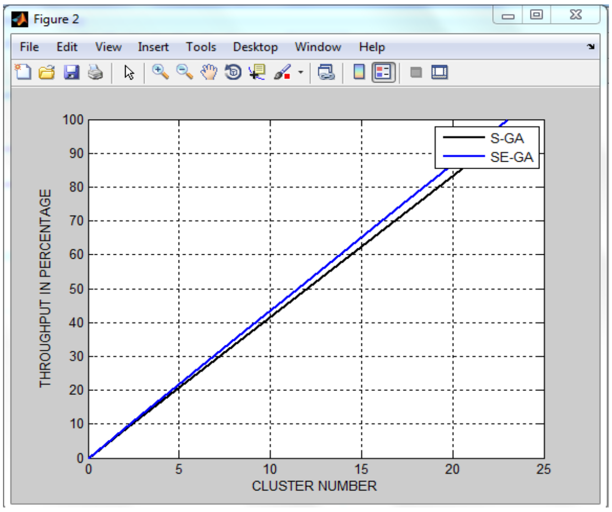


**Figure.9** Throughput

In above figure, a graph is plotted in between throughput and cluster number utilizing GA. Throughput is the number of packets sent over the network in given time. Throughput is the average rate of successful messages delivered over a communication channel. Unit: bits per second (bps). It has been seen that SE (Speed Energy) -GA performs better than S (Speed) -GA. Throughput will be measured as following:

throughputa=mean(throughput);
throughputa12=mean(throughput12);

```
gh=length(path);
thpt1=0:throughputa/gh:throughput;
thpt2=0:throughputa12/gh:throughputa12;
```

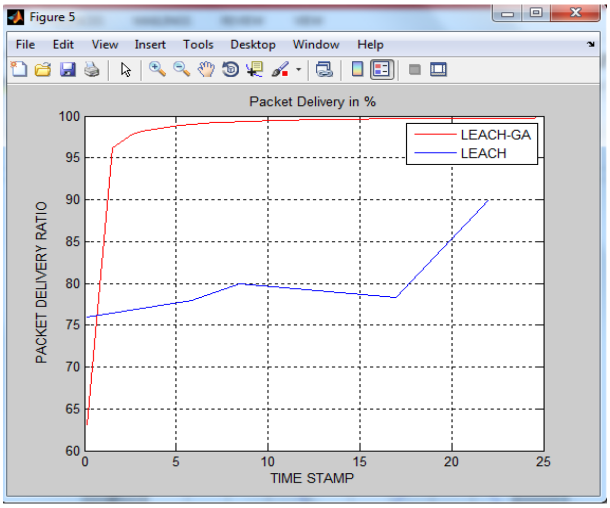


**Figure.10** Packet Delivery Ratio

Above figure shows the comparison graph for packet delivery ratio using LEACH-GA as well as LEACH only. From the graph it has been clearly shown that LEACH-GA has good packet delivery ratio than the LAECH protocol only. Packet delivery ratio has been measured as below:

Packet delivery = Total packets delivered / Total no. of packets

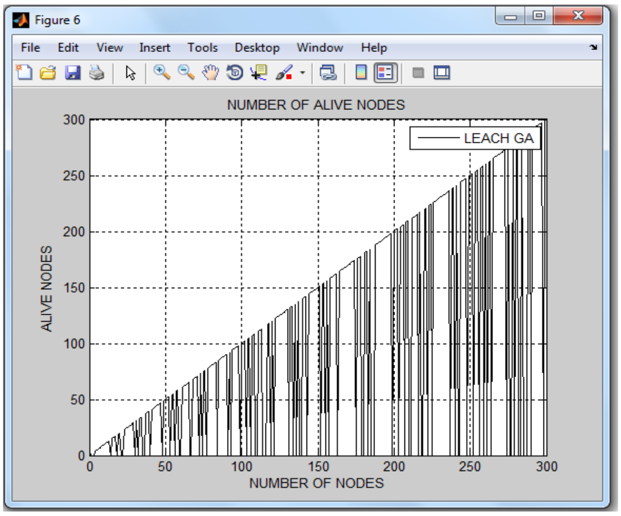


**Figure.11** Number of alive nodes using Leach protocol with Genetic Algorithm

In above graph, we have shown the number of alive nodes generated after applying leach protocol with Genetic algorithm. Alive nodes are those nodes which are helpful in data transmission. In above graph number of nodes are directly proportional to alive node such that at some point let say 100 the total amount of alive node is 100 as shown in above.

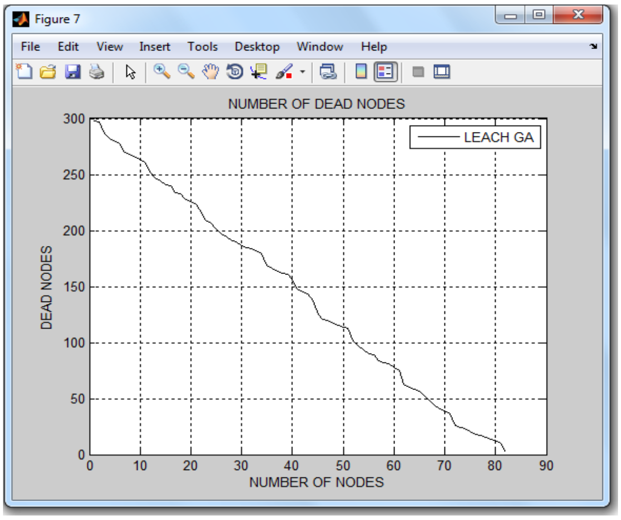


**Figure.12** Number of dead nodes using Leach protocol with Genetic Algorithm

Above graph, demonstrates the total number of dead nodes present in the network after applying leach protocol with genetic algorithm. In this dead nodes states that kind of nodes which are not useful or provide any help in data transmission in the network. As shown in this graph after implementing proposed work dead nodes value decreases as there is increase in number of nodes such that it can be illustrated by taking an instance in which at certain point let's say when number of nodes are 40 then number of dead nodes decreased from 300 to 150 as demonstrated in above graph.

**Table 1:** Performance parameters

| Parameters | Without GA | | | With GA | | |
|---|---|---|---|---|---|---|
| Time stamp | 5 | 10 | 20 | 5 | 10 | 20 |
| Energy Consumption | 8.5 | 5.6 | 5 | 1.5 | 1.8 | 2 |
| End Delay | 2.7 | 1 | 2 | 1.7 | .5 | 1 |
| Throughput | 20.4 | 85 | 93 | 20.6 | 87 | 100 |
| Packet Delivery | 77 | 85 | 90 | 97 | 100 | 100 |

Cluster formation and cluster head selection techniques are employed to achieve better operation and the prolong network lifetime by minimizing energy consumption. LEACH (Low Energy Adaptive Clustering Hierarchy) includes a new distributed cluster formation technique that enables self-organization of large number of nodes, algorithms for adapting clusters and rotating cluster head positions to evenly distribute the energy load among all the nodes. So in earlier work PSO (Particle Swarm Optimization) Technique has been utilized using various parameters to optimize the energy consumption in network. In proposed work PSO will be replaced by genetic algorithm to enhance the rate of energy optimization, as PSO does not have genetic operators so its working is slows w.r.t GA. The GA mainly works using fitness function optimization and can be described as:

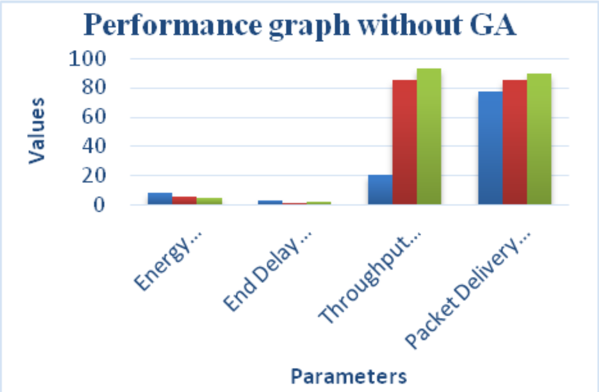


**Figure 11.** Performance Graph without GA

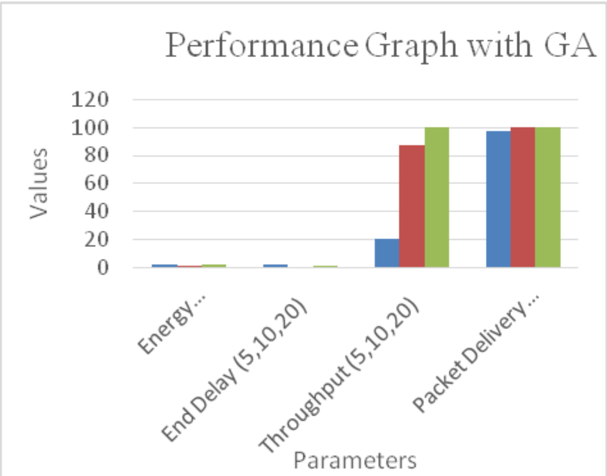


**Figure 12.** Performance Graph with GA

**Table 2:** Energy Consumption

| Parameter | LEACH-PSO (Base) | LEACH-GA (Proposed) |
|---|---|---|
| Energy Consumption | 5% | 2% |

Above table shows that energy consumption using LEACH+PSO is 5% whereas using LEACH+GA it is 2%.

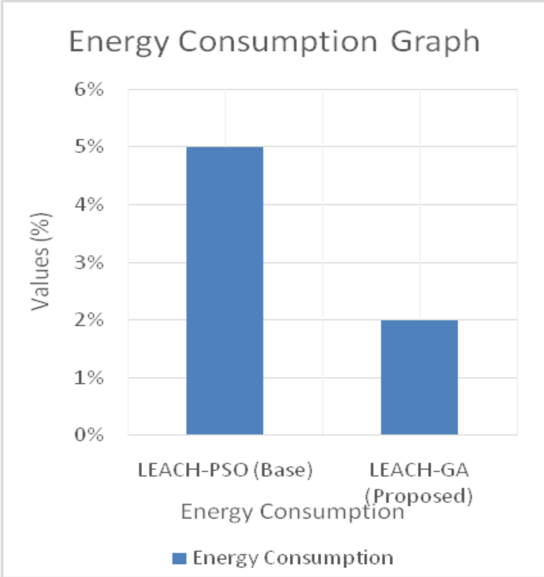


**Figure 13:** Energy Consumption Performance

## VII. CONCLUSION AND FUTURE SCOPE

In this paper, an advanced optimizes Genetic Algorithm (GA) algorithm has been implemented to minimise energy consumption when leach protocol is used. Main concept behind the wireless sensors network is to save energy more and more so that it works last long enough. This is due to fact that the size of a sensor node is expected to be small and this leads to constraints on size of its components i.e. battery size, processors, data storing memory, all are needed to be small. So any optimization in these networks should focus on optimizing energy consumption to enhance WSN life time. In our proposed algorithm the energy consumption is more balanced as compared to the other optimization algorithms. The simulation result shows that the network lifetime is improved in case of proposed scheme. As from the simulation results, it has been also concluded that the nodes are balanced in the network.

The investigations of energy-efficient communication in wireless sensor networks provide many future research directions. Thus, as a second future step, we aim at implementing each of the proposed solution and even their fusion over a real sensor network testbed. Moreover, while recent research effort in WSNs has started conceiving practical protocol implementation and real testbed evaluations, most of these studies have limited scope in terms of network size. To overcome this limitation, design and deployment of a vast area sensor network testbed that consists of heterogeneous wireless sensor motes is of great importance. Deploying such a large scale network will enable important WSN achievements. First, the ultimate testing of communication protocols scalability will be henceforth feasible. Second, unpredictable novel cross-layer interactions are highlighted. Finally, with vast area sensor network testbed, many useful WSN applications (e.g., network health monitoring) can become a reality.

**REFERENCES**

[1] S. Lindsey and C. S. Raghavendra, PEGASIS: power efficient gathering in sensor information systems, Proceedings of the IEEE Aerospace Conference, Big Sky, MT, USA, pp 1125-1130, March.
[2] Genetic algorithms overview. http:http://www.doc.ic.ac.uk/~nd/ surprise_96/journal/vol4/tcw2/report.html, October 2008.
[3] Sandra Sendra, Jaime Lloret, Miguel García and José F. Toledo, "Power saving and energy optimization techniques for Wireless Sensor Networks" IEEE, Vol.6 pp. 439-452, 2011.
[4] Raghavendra V. Kulkarni, Senior Member, IEEE, and Ganesh Kumar Venayagamoorthy, Senior Member, "Particle Swarm Optimization in Wireless Sensor Networks: A Brief Survey"IEEE, 2010.
[5] Gogu, A.; Nace, D. ; Dilo, A. ," Optimization Problems in Wireless Sensor Networks",IEEE, pp. 302-309 2011.
[6] Debmalya Bhattacharya1 and R.Krishnamoorthy, " Power Optimization in Wireless Sensor Networks " IJCSI, Vol.8, pp.415-419,2011.
[7] Jun Luo and Liu Xiang, "Prolong The Lifetime ofWireless Sensor Networks Through Mobility: A General Optimization Framework" IEEE, pp. 583-590.
[8] M. M. Chandane, S. G. Bhirud, S. V. Bonde, "Mobile Communication and Power Engineering Communications in Computer and Information Science Volume 296, pp 33-40, 2013.
[9] Y. Sankarasubramaniam, I. E Akyildiz and S. W. Mchughli, "Energy Efficiency based Packet Size Optimization in Wireless Sensor Networks", IEEE, 2003.
[10] Yuebin Bai, Shujuan Liu, Mo Sha2 Yang Lu, Cong Xu, "An Energy Optimization Protocol Based on Cross-Layer for Wireless Sensor Networks", IEEE, Vol.3, pp.27-33, 2008.
[11] Yanyan Zhuang Jianping Pan," Probabilistic Energy Optimization in Wireless Sensor Networks with Variable Size Griding", IEEE, 2010.
[12] Tarique Haider1 and Mariam Yusuf, "A Fuzzy Approach to Energy Optimized Routing for Wireless Sensor Networks", IJAIT, Vol.6, pp.179-180, 2009.
[13] Sajid Hussain, Abdul W. Matin and Obidul Islam, "Genetic Algorithm for Energy Efficient Clusters in Wireless Sensor Networks", IEEE.
[14] Bojan, S. ; Inst. Mihajlo Pupin, Univ. of Belgrade, Belgrade, Serbia ; Nikola, Z., "Genetic algorithm as energy optimization method in WSN ", IEEE, pp.97-100, 2013.
[15] Ali Norouzi and A. Halim Zaim, "Genetic Algorithm Application in Optimization of Wireless Sensor Networks", Hindwai, 2013.
[16] Meena Malik1, Dr. Yudhvir Singh2, Anshu Arora, "Analysis of LEACH Protocol in Wireless Sensor Networks ", IJARSCCE, Vol.3, pp. 178-183, 2013.
[17] Chunyao FU, Zhifang JIANG1, Wei WEI2and Ang WEI, "An Energy Balanced Algorithm of LEACH Protocol in WSN", IJCSI, Vol.10, pp.354-359, 2013.
[18] Sayali Datir, Narendra Narole, "Review on Energy efficient Optimization of clustering process in WSN designs using PSO & BFO" e-ISSN: 2395 -0056 Volume: 02 Issue: 03 | June-2015.

Ms. Moninder Kaur is pursuing M.Tech. in Electronics and Communication Engineering from BBSBEC Fatehgarh Sahib Punjab.. Her current field of working is in **Performance evaluation Of QOS parameters in WSN Using GA**