ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 6 | Issue: 1 | January 2020 || Journal DOI: 10.36713/epra2013 || SJIF Impact Factor: 5.614||ISI Value: 1.188

CLUSTER LEADER SELECTION USING M-LEACH-BASED ROUTING PROTOCOL FOR EFFICIENT ENERGY IN WIRELESS SENSOR NETWORK

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ABSTRACT

In Wireless Sensor Networks the major problem of LEACH is how many clusters to form while processing. The significant number of clusters in each round disturbs the WSN architecture. To enhance lifespan of network and efficient energy on the architecture of WSN, Modish-LEACH is proposed in this paper. In Modish-LEACH, the selection of cluster leader is done by the BS and considers the highest energy of each cluster. Proposed protocol can give surety on the no. of formed clusters that are static on every round. Besides, this maintenance even would lessen energy consumption of each node, so the lifespan of the network is better than existing protocol. The major contribution of the Modish-LEACH algorithm is Cluster Leader (CL) selection and also maintains numbers of clusters are static for each round. NS-2 simulation engenders Modish-LEACH has a much better rendition based on the Quality of Services like alive nodes, lifetime, energy consumption, throughput, and efficient energy.

KEYWORDS-*Wireless Sensor Networks, LEACH, Clustering, Quality of Services, Modish-LEACH, Cluster Leader and Efficient Energy.*

I. I NTRODUCTION

WSN is a Network of computers that comprise of various kinds of sensor motes. Each and every sensor mote can interact and collect data from its surroundings [1]. WSN The implementation of WSN is at unvisited areas. In terms of natural disaster, detect earthquakes, tsunamis, floods, and landslides etc.

The main focus of research on energy efficiency in the sensor mote (SM) that occurs when the first SM dies, it leads to unbalance the network [3]. Sensor mote has less storage capability, the span of the battery is short, and confined processing. So that an important scenario is to consume less energy and gives high performance with proper utilization of resources. The sensor mote has longer battery life and then increase WSN applicability, also system still demands a network that consumes less energy and enhance network life span more efficiently [4-5].

Energy efficiency is one of the ways to analyse infrastructure in computer network directly with the help of integration [6]. Sensor motes have less battery life in WSN, because motes require battery replacements regularly it leads to expensive network [7]. WSN operations can be controlled by changing its battery but significantly also increases the battery size, cost, and weight. Recent Research mostly on how to save sensor mote energy with the help of Energy efficiency methods for extending battery life [8].

Howbeit, sensor motes lifetime is remains narrow. Whereas, application life time is increases by this technique. WSN considerations like Scalability parameters, fault tolerance, operating environment, etc. The major limitation of WSN is lack of energy resource which impedes the process [9].

In Routing protocols, basic and prominent clustering protocol is LEACH. Because, LEACH has been proven as best energy saving routing protocol. This protocol is efficiently in transferring data to BS [10]. The major functionality of this routing protocol as capable of making cluster and procure data from cluster members and forwarding to the BS [11].

Nowadays, there are various flavours of LEACH are available for executing grouping of nodes to improve energy efficiency. In Ma et al [12], proposes an increase in power-based LEACH-C, namely Low Energy Adaptive Clustering Hierarchy-Central Construction (LEACH-CC). This method can balance the distribution of network energy by making the ambit of nodes into cluster heads. The LEACH-CC can increase the life of the network compared to its comparability. By presenting an evaluation scheme and architecture, its performance uses analytic and simulation studies. In Abushiba et al [13]

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proposes for WSN, a lifelong network in adaptive and energy-efficient grouping and (CH-LEACH). This protocol is used to ensure energy balance and extend network life. CH-leach presents reducing in energy consumption when compared with exiting protocols like LEACH and DEEC.

This research describes Modish-LEACH routing protocol, it was simulated by NS-2 environment. In the proposed protocol, CL has been selected based on the residual energy of each and every node. This mechanism avoids selecting as CL which is having less residual energy. Then which leads to enhance the life span and performance of WSN. Then analyze and compare LEACH and Modish-LEACH on Lifetime, Energy Efficiency, Throughput, and data received at BS.

II. WSN CLUSTERING PROTOCOLS

1. Formation of LEACH Parameter and Algorithm

LEACH algorithm comprises of two important parts like steady-phase and setup-phase. The primary one is setup phase, its functionality is clusters formation. Determine a cluster Leader to the joining of Cluster Members (CM) to each cluster leader. Determination of cluster leader is based on certain computations. Each threshold is computed, and then a random number is generated between 0 and 1 for each and every node. After threshold computation we get 2 values. A node which is elected as Leader of the cluster in the previous round, then its threshold value is 0. When a node which is not yet been elected for the cluster leader in the previous round, then it computes threshold value according to a certain formula. Then there is a provision whether the value of random numbers is less than the threshold value in each round then that node is elected as cluster leader for that round. If random number is more than the threshold value, then the node is the cluster member. Steady state is the next phase, which is most important and used to transmission of data from cluster leader to BS, which is collecting from cluster members of different clusters.

A. Setup Phase

Cluster Lead Selection

The primary step is cluster leader selection. Several provisions are used in this selection procedure. The primary goal is to find out required cluster number (k), where k is the input value. Then next one is to compute the threshold value for each and every node. The following formula is used to compute threshold ($TH_i(t)$) in equation (1):

$$TH_i(t) = \begin{cases} \dfrac{k}{N - k * \left(r \bmod \frac{N}{k}\right)} & : TH_i(t)=1 \\ 0 & : TH_i(t)=0 \end{cases} \quad (1)$$

From equation (1), we get 2 different values in the threshold computation. The first value comes from the provision of $TH_i(t) = 1$. This provision represents that the node is never a cluster leader in (r mod N/ k) past round. Here r represents the number of rounds that have been executed before, N represents total of nodes, k represents required number of clusters. While $TH_i(t) = 0$ is next value from equation (1). Then each node being a cluster leader remaining N / k rounds.

Cluster Formation

Cluster leader is elected by using the possibility of threshold value in the equation (1), the CM located on the sensor network must know that the CL is a node in the round. This process, elected CL is sending an advertisement message to cluster members as join_req within the network, willing CM are send their acceptance then form cluster using CSMA MAC protocol. In the message, the node conveys the ID and a header by the node that is the cluster leader for distinguishing this request as a notification request. Each CM determines its respective cluster by electing CL with the minimum communication energy required, based on the signal strength received from sending messages for each CH closest to that node.

B. Steady-state

The data is procure from the cluster member and forward to its corresponding CL and it aggregates collected again forward to the BS. The major function of the steady-state is electing Cluster Leader based on certain parameters and cluster formation based required cluster members (CM). When the sensor mote carts data from the CM to the CL, node is set by the cluster leader of data sent according to the specified time period. The data transmission duration for each and every node is constant, so the data transmission period depends on the number of motes in the CM of clusters. In the steady phase, the Cluster Leader must always be alive to store data from the CM in the clusters. If the delivery distance and data receiver are package one, then the consumption energy used to send data is by the equation (2):

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$$E_{Tx}(l,d) = E_{Tx-elec}(l) + E_{Tx-amp}(l,d) \quad (2)$$

$$= \begin{cases} lE_{elec} + l_{\epsilon fs}d^2, & d < d_0 \\ lE_{elec} + l_{\epsilon fs}d^4, & d \geq d_0 \end{cases}$$

And consumption energy to receive data is by the equation (3):

$$E_{Rx}(l) = E_{Rx-elec}(l) = lE_{elec} \quad (3)$$

E_{elec} in equation (2) and (3) is energy used to operate circuits on radio devices from nodes, whereas E_{amp} is energy to strengthen information signals so that signals that arrive at the receiver still meet the minimum value that limits the reception of information signals to the receiver or called receiver sensitivity [14].

III. S YSTEM D ESIGN

A. Modish-LEACH Protocol Algorithm

Our proposed protocol in this research is called as Modish-LEACH which augments the rendition of the existing protocol. The existing protocol does not bestow an optimal solution for the placement and no. of cluster leaders. Whereas the cluster has adaptive by nature so that easy to adjust to the area so, the cluster formation is not optimal during the setup phase does not have a big impact on the network rendition. Howbeit, a centralized control algorithm to make clusters will put together clusters with evenly distributed leader clusters athwart the network. This underlies the Modish-LEACH by using a centralized clustering algorithm that has the same stable process as the LEACH protocol.

The selection of cluster leaders is based on an algorithm called the Modish-LEACH. Location and its level of energy information to the BS is sent by each node during the Modish-LEACH setup phase. In determining the optimal cluster, BS ensures that energy is distributed to all motes by computing the every nodes average energy then decides, if any nodes have below average energy. It is happened to see for nodes that can be cluster leaders. Then the amount of energy in a node other than the cluster leader is lessen by this protocol when forwarding data to the cluster leader. The total of the squared distances between all nodes additionally the cluster leader with the nearest cluster leader is reduced.

There is a form if the cluster leader and cluster members join; the BS propagates a message that comprises of CL ID for each node. If the CL ID equals the node ID, then the node is the cluster leader. Whereas if the CL ID does not equal then the node will determine the TDMA slot for data transmission and then the node rests until it's time to send data. The new stable phase of LEACH is identical to LEACH. The Parameters used to compute the energy computation equation from the node. Equation (4) is Modish-LEACH NL (ni) energy computation for cluster leader selection:

$$NL(n_i) = (1-\alpha) + \frac{\sum_0^j NL(n_j)}{d_{out}^{ji}} / \sum_{k \epsilon Neighbor} d_{out}^{jk} * CO(n_i) * \alpha \quad (4)$$

From the equation (4), NL is the neighbouring list for the k, d_{out}^{ji} is the distance between edges of the out link from node j to node i, CO(ni) is the current energy of the node i and α is the damping factor [15]. The remaining energy of the node when electing as a cluster leader is not advised by LEACH protocol. It can cause to become cluster leaders by nodes with very less energy and initial outages from clusters that affect the lifespan of the complete network. And the LEACH protocol does not advise good nodes when choosing a cluster leader that can cause some bad nodes to become cluster leaders, thus falsify procured data. With the help of new algorithm in Modish-LEACH, when choosing cluster leaders, we consider the energy node, thus evading the low-energy node to become a cluster leader between clusters and other clusters. Figure 3 demonstrate the process of Modish-LEACH routing protocol:

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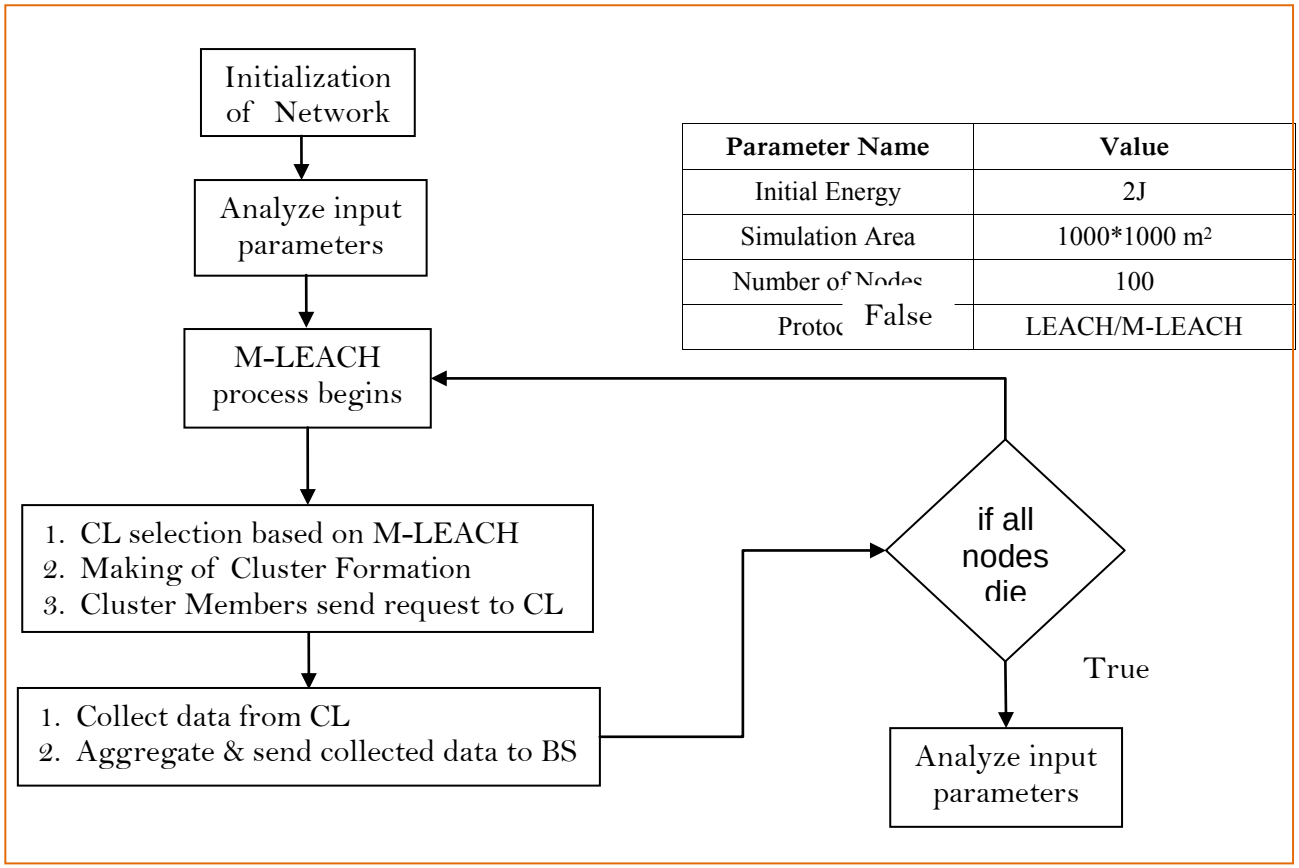

Figure 3 Flowchart of the Modish-LEACH routing protocol

From equation (4), the Modish-LEACH comprises the distance between nodes to BS, the distance of nodes to each node in the cluster, the computation of the less energy from Modish-LEACH energy, and which is not yet elected as CL in the previous rounds. By removing nodes which not fulfil the requirements of being CL from the start and prioritizing the nodes that are most qualified to become CL, the selection of CL will be shorter and require less time.

B. Network Model

We assume that number of 'n' nodes has been diffused over the MxM area. BS locates at the central of the sensor network. This simulation decision is as follows:

i. All nodes are random.
ii. All nodes have same energy initially.
iii. The ability of all the nodes is received and sends data.
iv. If energy is exhaust, nodes are no longer useful in the network.

IV. SIMULATION AND PERFORMANCE ANALYSIS

Simulation of the WSN and its performance evaluation has developed on NS2. The sensor nodes have been deployed randomly in a sensor-field which having dimensions of 1000 ×1000 sqm. The numbers of nodes are 100. The simulation Parameters are: The following Performance Metrics have been analysed:

1. Nodes alive Vs Rounds
2. Lifetime Vs No. of clusters
3. Energy consumption Vs No. of clusters
4. Throughput Vs No. of clusters

The following experiments are the results of the average lifetime, energy consumption, throughput, and efficient energy of each experiment in the number of clusters. There are figures 4-7 of some QoS for the LEACH Vs Modish-LEACH routing protocol:

From the figure 4, represents alive node with respect to rounds, in the Modish-LEACH algorithm gives better results than LEACH algorithm where the triangle symbol on the graph shows higher than the square symbol. The LEACH starts losing 20 nodes at round 510. Then in round 620, all nodes for the LEACH algorithm eventually die while the Modish-LEACH algorithm needs a round of 870 for all dead nodes

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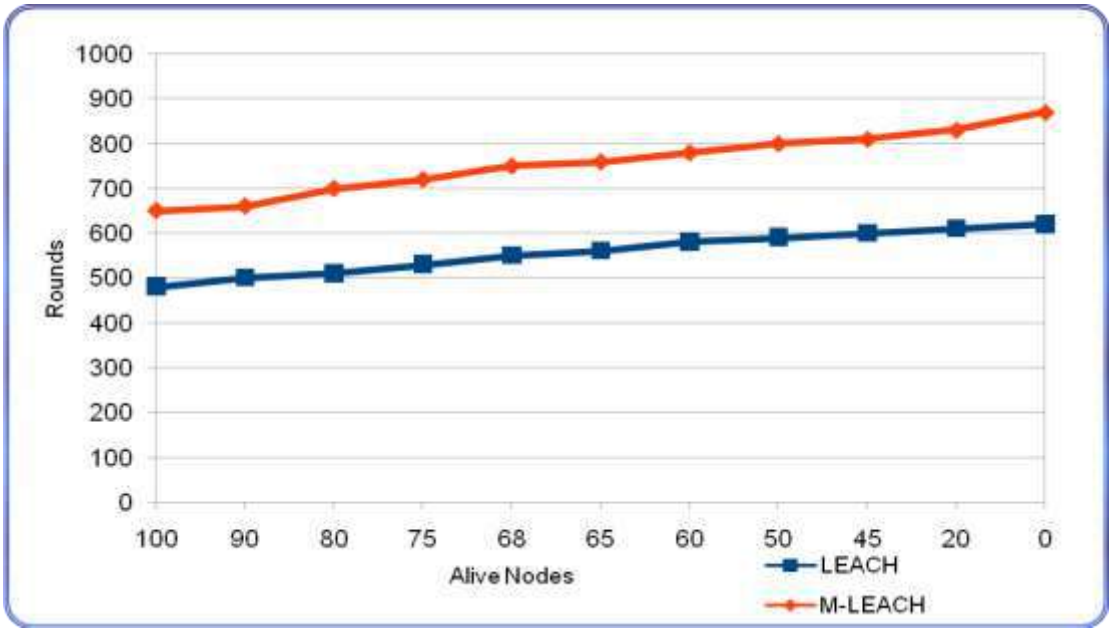

Figure 4: Node alive between LEACH and Modish-LEACH

From figure 5, represents lifetime of the network with respect No. of Cluster of the Modish-LEACH is gives better results than the LEACH algorithm. The triangle symbol from the graph always shows top than the square symbol of each number of existing clusters.

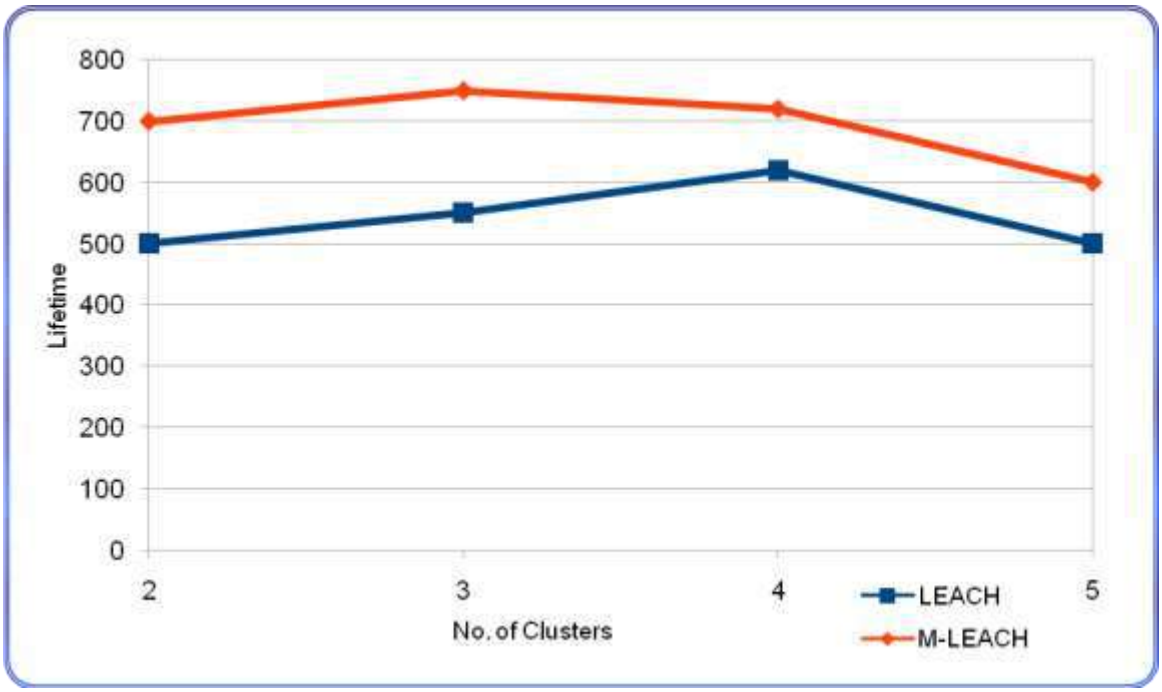

Figure 5: the lifetime of LEACH and Modish-LEACH

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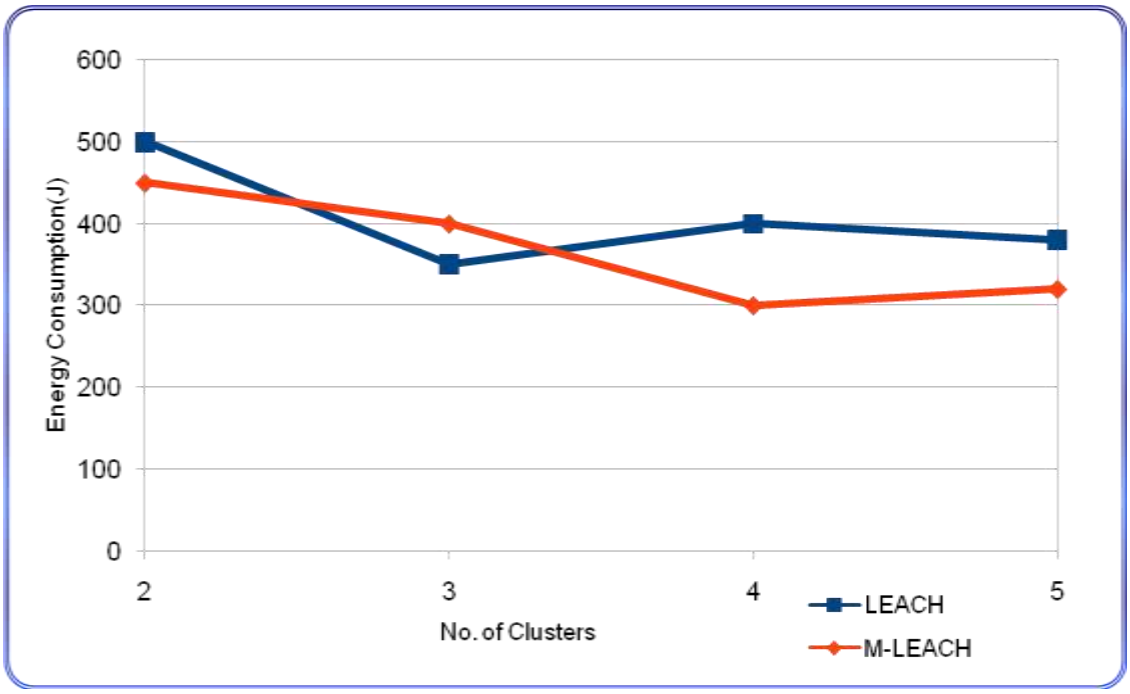

Figure 6: Energy Consumption of LEACH and Modish-LEACH

Figure 6 represents Energy Consumption with respect to No. of clusters. Energy consumption, the triangle symbol of the graph does not always show lower than the square symbol of each cluster number. At the 3 cluster, Modish-LEACH energy consumption has a higher than LEACH protocol.

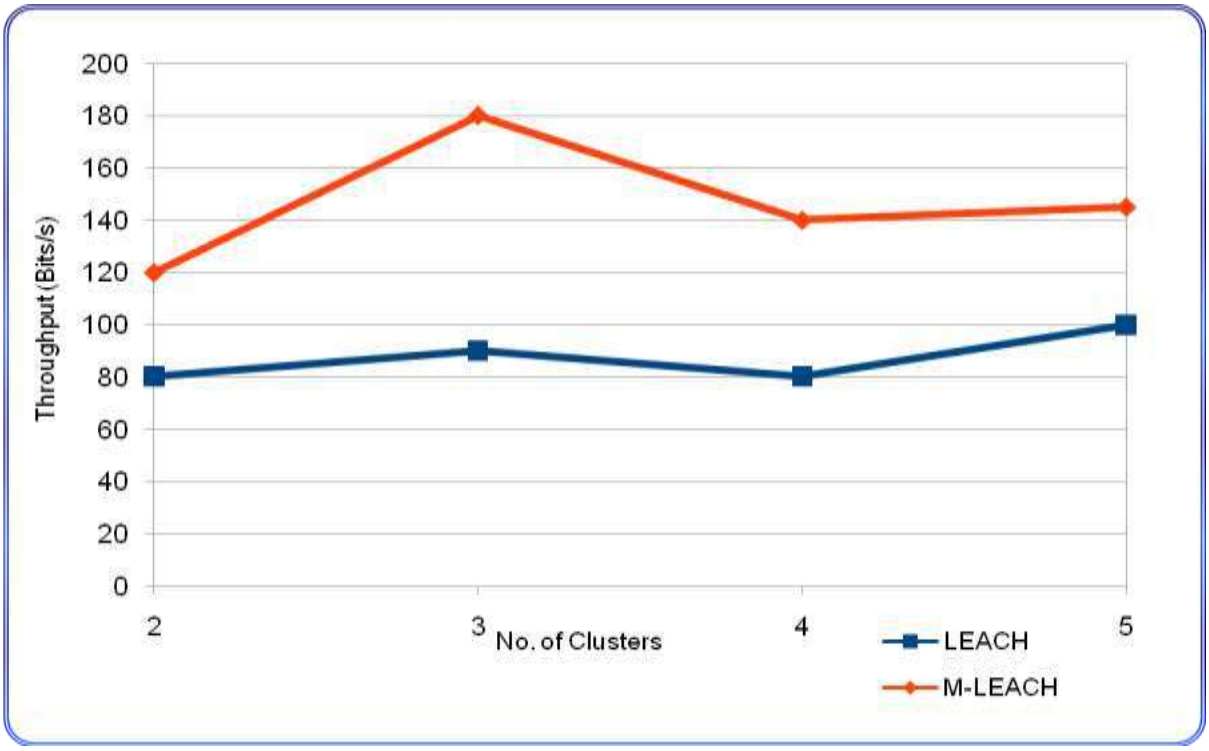

Figure 7: Throughput of LEACH and Modish-LEACH

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Figure 7 represents throughput with respect to the No. of clusters for LEACH and Modish-LEACH.

V. CONCLUSION AND FUTURE WORK

The proposed Model engenders better performance than LEACH protocol, based on the Quality of Services. The major objective of this paper is selection of Cluster Leader to enhancing the life span of the WSN. When electing a CL, consider the rest of the nodes energy and choose the highest energy nodes from all nodes in each cluster and proscribe nodes those with destitute energy. The performance analysis of Modish-LEACH is implemented and evaluated by using NS2 simulator and compared with existing algorithm having parameters as alive nodes, life-span, energy consumption and throughput. Further futuristic augments of my protocol to diminish the energy consumption which increases life span and it will be efficiently protected with the dynamic attacks.

Throughput, the triangle symbol from the throughput graph shows top than the square symbol.

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