# LEACH Partition Topology for Wireless Sensor Network

M. Udin Harun Al Rasyid[1], Bih-Hwang Lee[2], Iwan Syarif[1], Mokhammad Muqoffi Arkham[1]
[1]Politeknik Elektronika Negeri Surabaya (PENS), Surabaya, Indonesia
[2]National Taiwan University of Science and Technology, Taipei, Taiwan
udinharun@pens.ac.id, bhlee@mail.ntust.edu.tw, iwanarif@pens.ac.id, muqoffi29@gmail.com

***Abstract*—LEACH has major issues regarding the number of clusters formed. The fluctuation significantly number of clusters in each round destabilizes the wireless sensor network (WSN) architecture. In order to produce a better lifetime on the architecture of WSN, LEACH partition topology (LEACH-PT) is proposed in this paper. In LEACH-PT, cluster head (CH) is chosen by the base station (BS). It can guarantee the number of clusters formed is fixed on each round. In addition, this action will also minimize the burden of energy consumption at each node, resulting network lifetime better than LEACH. In addition, the distribution node is done evenly to the specific provisions than the existing random topology on LEACH. It is also a major focus on the LEACH-PT algorithm. The result of the simulation using network simulator 2 shows that LEACH-PT has significant better performance in term of nodes lifetime than that of LEACH.**

***Keywords— Wireless Sensor Network, LEACH, LEACH-PT, Clustering, Partition***

## I. INTRODUCTION

Wireless Sensor Network (WSN) is an advanced intelligent network which organized by amounts of functional sensor nodes. The sensor nodes in WSN can send data and collaborate with each other to achieve some special functions through actualizing the self-organization wireless communication manner. In addition, WSN can be widely applied in the following areas, such as medical, smart home, environmental, and agriculture monitoring area [1-2].

However, the main issue is about the energy consumption. This is caused by the power supply to the sensor nodes which is only supplied by the battery for its operation, so it has limited energy reserves. If one node dies or is not active, it will change the network performance in terms of routing and topology. According to that issue, Heinzelman et al. [3] proposed a Low Energy Adaptive Clustering Hierarchy (LEACH) algorithm, a clustering-based protocol that minimizes energy dissipation in sensor networks. LEACH is the first and the most popular cluster-based routing protocol. In LEACH protocol, the nodes establish themselves into local clusters, with one node become the cluster head. All non-cluster head nodes transmit their data to the cluster head, then the cluster head node performs signal processing functions on the data, and transmits data to the remote destination node.

The LEACH protocol will select cluster head nodes randomly, in this way the number may go astray from the most ideal cluster number. When the number of cluster is too few, energy consumption of cluster heads will increase and cause early death of those cluster heads; when the number of cluster heads is too excessive, it will cause transmission data overload of the sink node, which will affect the entire network energy consumption, thus shortening the life cycle of the WSN.

In order to further optimize the classical level routing protocol LEACH, many researchers have already shown up with numerous investigations related to how to improve LEACH cluster head selection algorithm to prolong the network lifetime. Gou at el. [4] proposed an enhancement for LEACH algorithm called partition-based LEACH (pLEACH). pLEACH partitions the network become several optimal sectors and choose cluster head from a node with has highest energy using centralized calculations. The simulation results show that pLEACH gain better performance in terms of energy consumption and network lifetime. Chen et al. [5] proposed LEACH-G to determine the optimum number of cluster heads to reduce the energy consumption of sensor nodes. The simulation results show that the LEACH-G algorithm can increase the network lifetime. Mondal et al. [6] proposed rough fuzzy LEACH (RF-LEACH) where the selection of cluster head is done by fuzzy logic and cluster partitioning is based on rough fuzzy c means (RFCM). The simulation results show that RF-LEACH gains better in terms of throughput and network lifetime. Fan et al. [7] proposed energy-based clustering model (EBCM) scheme to balance the energy consumption of all nodes and reduce the network energy consumption. EBCM is based on LEACH which considering some factors such as energy level and degree in clustering process. The simulation results show that the EBCM algorithm can reduce the average energy consumption.

In this paper, LEACH-PT is proposed to guarantee the number of cluster that can extend the whole network lifetime. This paper analyzes the comparison of LEACH and LEACH-PT in terms of network lifetime.

## II. System Design

The process of cooperation can be divided into following phases. Phase begins by determining the number of clusters ($k$) to be formed. Then we set up the initial topology such as the preparation of topology rules in pLEACH [4]. Location of BS is always in the center of a network or as polar coordinate. The spread of the number of nodes split evenly across each sector.

Unlike pLEACH, the formation of sector cluster in LEACH-PT is different for each round. That is because the election CH by BS at the next round come from the node with the highest residual energy in the whole network, not in every sector. pLEACH setup the same cluster formation area of each round corresponding initial topology, whereas in LEACH-PT area of cluster formation can be different every round. This is due to differences in the mechanism of determining the cluster head in pLEACH and LEACH-PT. Thus, the formation of clusters LEACH-PT the next round will be different than the previous round as shown in figure 1.

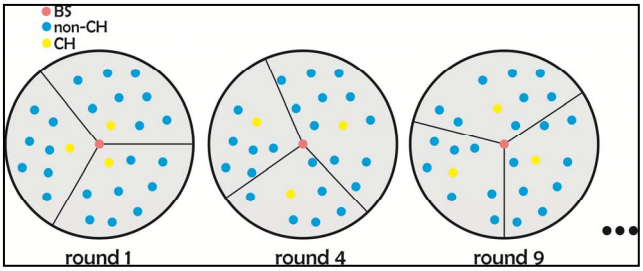



Figure 1. Cluster formation in LEACH-PT

## III. Performance Evaluation

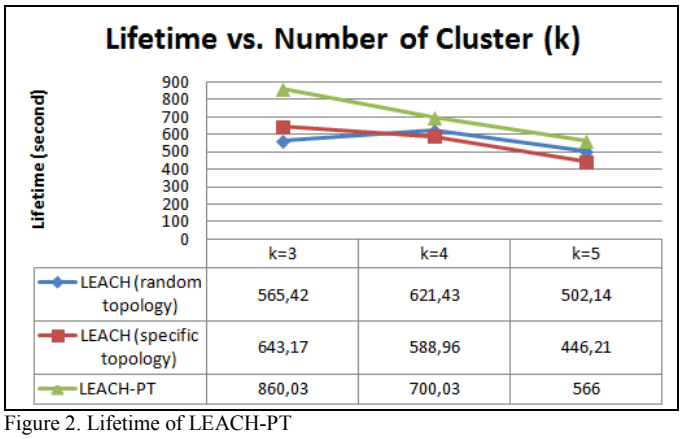
There are two main parts of the performance evaluation, which is about the evaluation of LEACH and LEACH-PT algorithm. The performance comparison between LEACH and LEACH-PT is based on lifetime of nodes. We use network simulator 2 on Ubuntu 10.04 LTS. Then we do the cluster formation visualization using Matlab based on the results of the simulation.

The algorithm test is LEACH-PT simultaneously with LEACH algorithm. Testing LEACH uses the same topology as the testing LEACH-PT algorithm, namely the partition topology. In the experiment below which compares the results lifetime of the network changes the expected number of clusters ($k$).

Figure 2 show the performance of three types of data, ie. LEACH algorithm (random topology), LEACH (topology partition), and the algorithm LEACH-PT. From the above experimental results, the most optimal network lifetime is LEACH-PT, where the highest reaches 860 seconds.

## IV. Conclusion

Problems limitations on WSN energy use raise many of the modeling algorithm protocol for efficient communication. LEACH is the first and most famous algorithms that focus on energy consumption. Proponent modeling LEACH provide a loophole for further research on the instability of the number of clusters that formed in each round. Therefore, LEACH-PT proposed to address the stability of the number of clusters that formed in accordance with the desired number of clusters. The simulation result shows that LEACH-PT capable predominantly produces the effectiveness of the network is better than LEACH based on lifetime of nodes. For further research, we will analyze the others quality of service (QoS) such as node alive, energy consumption, data received Base Station, energy efficiency, and throughput.




| | k=3 | k=4 | k=5 |
|---|---|---|---|
| LEACH (random topology) | 565,42 | 621,43 | 502,14 |
| LEACH (specific topology) | 643,17 | 588,96 | 446,21 |
| LEACH-PT | 860,03 | 700,03 | 566 |

Figure 2. Lifetime of LEACH-PT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