LEACH-T: LEACH Clustering Protocol Based on Three Layers

Mustafa A. Al SIBAHEE[1], Songfeng LU[1], Mohammad Z. MASOUD[2] ,Zaid Alaa HUSSIEN[1,3],
Mohammed Abdulridha HUSSAIN[1,4], Zaid Ameen ABDULJABBAR[1,4]

[1]School of Computer Science and Technology
Huazhong University of Science and Technology, Wuhan, 430074, China
[2]Computer and Communication Engineering Department
Al-Zaytoonah University of Jordan, Amman, Jordan
[3]Southern Technical University, Basrah, Iraq.
[4]University of Basrah, Basrah, Iraq
MUSTAFA.A@hust.edu.cn, lusonqfeng@hust.edu.cn

Abstract—**Power consumption of routing protocols is one of the main issues that wireless sensor networks (WSNs) encounter in their lifetime. Low-Energy Adaptive Clustering Hierarchy (LEACH) clustering protocol was introduced to reduce power consumption. However, in LEACH, power consumption increases massively as the distance between sink node and cluster heads (CHs) increases. This drawback introduces distance as one major issue in LEACH since it does not contain routing. In this work, a LEACH based protocol consists of three layers (LEACH-T) is proposed. Each layer has its own CHs. The layers attempt to reduce the distance between sink node and CHs. The third layer is utilized if the distances between CHs and sink node exceed a threshold value. To measure the performance of LEACH-T, simulation is utilized to compare its consumption to pure LEACH. Results show that the proposed protocol extends network lifetime and reduces power consumption.**

Keywords- LEACH, LEACH-T, Wireless Sensor Network WSN, Power Consumption, Network Lifetime

I. INTRODUCTION

Wireless sensor network (WSN) plays an important role in the information industry in the 21st century and is widely applied in military, environmental monitoring, medical care, and smart home applications [1]. WSN is a distributed system consisting of a number of sensor nodes and a sink node that collects data from the sensor nodes. The power of sensor nodes is an issue in designing WSNs. Sensor nodes are powered by batteries, which are limited in energy and present difficulties when requiring frequent changes or charging batteries. Therefore, sensor nodes have emerged as a research hotspot.

An important power-consuming component in WSN is the routing protocol. Routing protocols require power when receiving and transmitting the data of other nodes. This power is considered an overhead for these nodes. However, without routing, remote nodes cannot deliver their data to the collector "sink node" [2]. This deficiency revealed the necessity of tailored routing protocols that reduce power usage to prolong the lifetime of sensor nodes.

A cluster-based network structure can balance the energy consumption of network nodes [3]. Low-Energy Adaptive Clustering Hierarchy (LEACH) protocol is one of the first clustering protocols for WSNs [4] and is one of the most famous clustering techniques. It divides an entire network into groups called clusters. A cluster consists of many sensor nodes and a cluster head (CH) [5]. The CH collects sensed data from sensor nodes, and then aggregates and transmits them to the base station (BS). Given that sensor nodes do not need to communicate with the BS [6], communication burden is decreased. Therefore, energy consumption is reduced and network lifetime is increased accordingly [7]. In hierarchical approaches such as clustering, the data at higher levels of hierarchy are more important than those at lower levels. Numerous protocols have emulated LEACH and extended its structure [8]. These protocols are called LEACH descendants. However, one issue remains in these protocols, namely, the distance and power assumptions of LEACH protocol. These protocols of the WSNs discuss results on how to reduce network power consumption and extend expected network lifetime. Although these questions have been addressed often in past LEACH descendants [9], so far, no definite, simple predicting algorithm for achieving these goals and understanding often unpredictable behaviors better has been developed.

To this end, a new LEACH descendant routing protocol is proposed in this work. This protocol is a three-layered LEACH protocol that tackles the issue of distances in LEACH protocol. The proposed protocol is called LEACH three (LEACH-T). LEACH-T nominates three layers of CHs. The first layer of CHs gathers data from sensor nodes in its clusters. The second layer of CHs gathers data from CHs. Finally, the third layer of CHs is utilized if the distance between the second-layer CHs and sink nodes is vast. LEACH-T attempts to reduce power consumption in the network on one hand and tackle the distance issue between CHs and sink nodes on the other hand.

The contribution of this work is summarized as follows:
- Proposing a LEACH-based protocol called LEACH-T to prolong network lifetime.
- The new protocol is a hierarchical protocol that creates clusters for CHs to form a second clustering layer.