LEACH IN MULTI-AGENT HYBRID ROBOT ARCHITECTURES

Andrei-Mihai LUCHIAN[*], Cristian-George CONSTANTINESCU[**]

[*]Transilvania University, Brașov, România, [**]Air Force Academy "Henri Coandă", Brașov, România

DOI: 10.19062/2247-3173.2016.18.1.20

Abstract:*In the last decade research in wireless sensor networks has drawn attention due to the advantage regarding surveillance of phenomena's in different backgrounds. The life extension of networks, scalability and balance of recharging are just a few important parameters for wireless sensor networks. Grouping the nodes is an efficient technique to obtain such results. In this paper we will introduce an algorithm for energy efficiency in node groups based on a LEACH protocol. LEACH (Low Energy Adaptive Clustering Hierarchy) is one of the most known solutions of node grouping in the last decade being proposed for any type of wireless sensor networks. LEACH protocols use TDMA (Time Division Multiple Access) based on a MAC protocol which optimizes the energy consumption. The proposed protocol will be used in a simulation program. As we can observe in the accompanying results, there is a slight reduction of energy consumption compared to the classical protocols.*

Key words: *WSN (Wireless Sensor Networks), LEACH protocol, lifetime extension of networks*

1. INTRODUCTION

Routing in WSN architectures represents a though challenge due to its distinctive characteristic: ad-hoc networks and cellular networks.

Over time there had been a lot of proposals regarding the algorithms due to its advantages in WSN applications and architectures.

Based on theadopted network, the protocols for WSN can be classified as:

- Flat network routing
- Hierarchical network routing
- Location-based network routing. [1]

Flat network routing is characterized by the use of all the nodes to fulfill the location and routing requirements.

Hierarchical network routing divides the network into groups to achieve scalability and energy efficiency. The most known version of it is LEACH. [2]

Location-based network routing uses the localization data of the nodes to commute the route. The location information can be provided using Global Positioning System (GPS), such a system being attached to each node.

While creating the topology of a network we can observe the fact that the routing setting process for a WSN is influenced by energy consumption.

LEACH protocols can reduce the alert because it doesn't need information regarding the location of the node or ways to manage the access point into the node. In doing so we reduce the energy that is used by a node and increasing its life support. We must point out that there are still issues regarding the location of mobile objects. Thus a new demand has appeared, protocols must support mobile nodes.

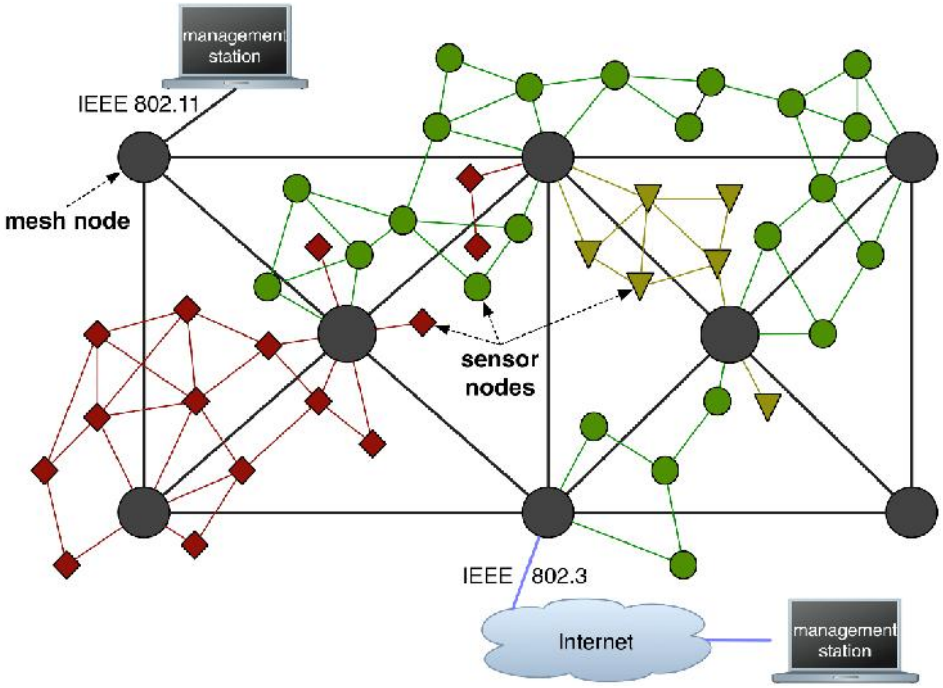

FIG. 1. WSN network structure [3]

2. LEACH

Node grouping is a hierarchical method for architectural structures. Using this method,nodes can streamline the radio resources and extend the lifetime of the batteries. Inside a group aggregations and fusions take place so it can reduce the volume of information that is transmitted to the cluster head. [2]

LEACH: The main idea is to create a group of nodes with sensors that are based on the signal power and use of the main node as a router so it can transfer data through the other nodes. This is a dynamic mechanism. At the beginning of the process, the group cluster head is chosen randomly based on the energy consume. Then each node with a sensor called “n” generates a random number between 0 and 1 and this number is being compared with a well-established limit called “T(n)”. If the random number is lower than T(n), that would mean that the node will become the cluster head in this process. If not, it will become a simple node in the group. T(n) is defined as [2], [4]:

$$T(n) = \frac{P}{1 - P\left(r \bmod \frac{1}{P}\right)} \qquad \forall n \epsilon G \qquad (1)$$

P=is the probability of cluster heads over all nodes in the network;

r=the number of rounds of selection;

G= is the set of nodes that are not selected in round $\frac{1}{P}$

After they become cluster heads, they send a message to the other nodes informing them who are the cluster heads. The other nodes will select the next cluster heads depending on the power of the signal from the message received. For each round the clusters heads are changed so it can equally disperse the energy consume, prolonging the lifetime of all nodes in this way. [4]

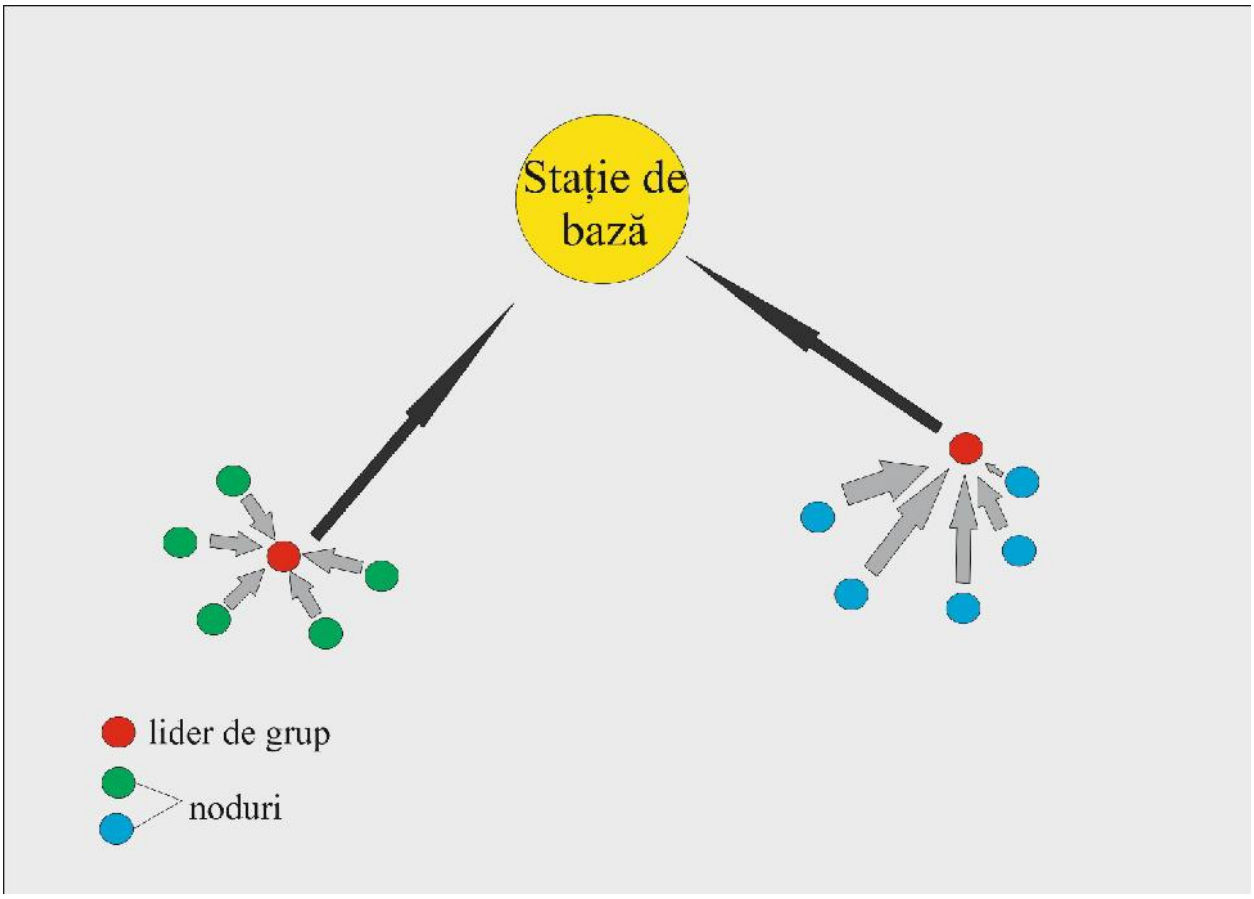

FIG.2. LEACH scheme

3. LEACH IN UAS

3.1. HISTORICAL DEVELOPMENT

In complex media software the airship and soil equipment must communicate in real time. Historically speaking, the designers of these systems have developed them as independent systems connected through LEACH-type complex, with a system management program included. Recently, air and ground platforms have become the main pillar in data transmission. Image intelligence offers clean information through data-flow, thus enhancing the evolution of the system.

UAV's require a tight connection with ground platforms. In the last decade, developers had made huge investments in data link and protocols. This fact influenced the range and time of flight, sensors, and the functionality of the system. There are a lot of widgets that offer data transmission, but data-links aimply create a route for an image signal and another for radio communications between air and ground platforms.

Having LEACH connections, the network can extend to an end-to-end signal which has a coherent architecture. Using end-to-end design developers could access information from any node, thus simplifying their information distribution. Of course, by combining different types of platforms for different types of missions the developers have stumbled upon new demands.

3.2. UAV-UGV

The composition of the UAV-UGV systems can be divided into three subsystems: air platform, ground platform and command center. Each subsystem has its own challenges.

3.2.1. Air and ground platforms

UAVs and UGVs are limited due to the operating environments, where battery resistance quality and the weight of the aircraft can be decisive factors. These subsystems must contain a flight computer, WSN, load management, and a weapon system if it is possible. The components will be interconnected in a variety of serial-buses and networks having a live operating system capable of real time data transmission.

3.2.2. Command center

Through assimilation this system is alike with a classic work station. The operating system (OS) is LINUX or WINDOWS with a diversity of applications for air and ground platforms, and with digital review of the data acquired. These three subsystems must contain data-link connections separate from the communication links so that the data-flow will not be affected.

3.2.3. Image Intelligence UAS

Of course, for a good functionality the applications of the system must work together and not as individual software's. Within a large range of missions, it is impossible to think that a single application can handle all the objectives. A single system was used in the past for a variety of missions, thus leading to large expanses regarding maintenance and software creation.

Nowadays, military architectural companies have upgraded the classical UAV, UGV systems in US (unmanned system) systems or combinations of platforms which can be used in a large diversity of missions. The advanced optic systems allowed these platforms to work in any weather conditions and in any environment. The issues of these systems are mainly the disconnections of the wireless satellite connection due to electromagnetic interference. Electromagnetic interference appears because of frequency similarity, thus reducing the imagery of the platforms in missions, resulting mistakes or even failure due to insufficient information.

3.2.4. Numerical simulation of LEACH in UAS

We realized a numerical simulation for a bunch of LEACH connections inside UAS systems, especially for a WSN in an UAS system.

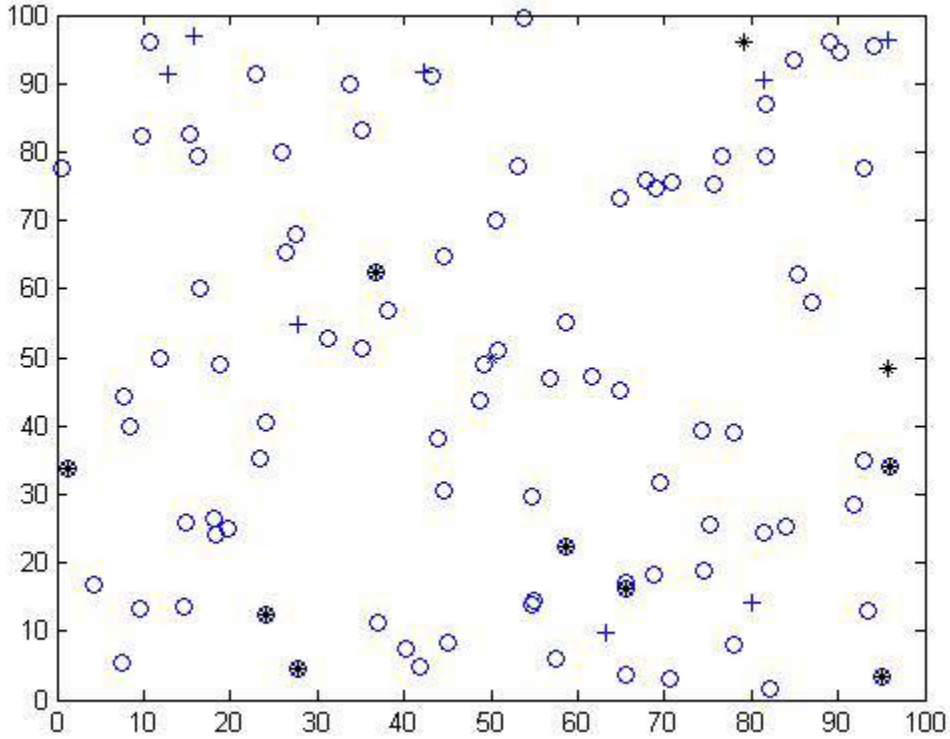

FIG. 3. LEACH in UAS

The nodes closer to the base are the first nodes that die. The further a node is from the base, the greater chances for it to die in case we start a direct transmission between the nods. The sensors that remain alive (simple circles) and the nodes that die (colored circles) have been through different stages of data transmission, so that we can find their weaknesses, but also to find the cluster heads (group leaders) which are symbolized with "+". [7], [8], [9], [10].

4. CONCLUSSIONS

LEACH protocols are appropriate for WSN when all the sensors from the nodes are identical and are charged with the same quantity of energy. Thus, each node knows the rate of energy consumption, being capable of controlling the rate transfer and distance. All the "communication ways" in the nodes are identical.

Any node can communicate with any other node, even if this node is a base station.

The base station is fixed point, which is far away from the wireless networks. Thus, we can ignore the energy consumption of the base station, assuming that the energy supply is from an external network and it has enough energy for its functionality. [5], [6]

Each node has data for transfer at each process.

The nodes with sensors are not static points (fixed points). They are in continuous movement.

REFERENCES

[1] Lu, Ye Ming and Vincent W. S. Wong, *"An energy-efficient multipath routing protocol for wireless sensor networks*" research articles. Int. J.Commun. Syst., 20(7):747--766, 2007.

[2] W. Heinzelman, A. Chandrakasan and H. Balakrishnan, *"Energy-efficient communication protocols for wireless microsensor networks"* Proceedings of the Hawaii International Conference on Systems Sciences, Jan. 2000.

[3] http://home.inf.unibe.ch/~rvs/research/mancom.html

[4] W. Heinzelman, A. Chandrakasan and H. Balakrishnan, *"An application-specific protocol architecture for wireless microsensor networks"*, IEEE Transactions on Wireless Communication, vol. 1, no.4, pg. 660-670, 2002.

[5] T.C. Hou, T.J.Tsai, *"An access-based clustering protocol for multihop wireless ad hoc networks"*, IEEE Journal on Selected Areas in Communication, July 2001

[6] M.Joa-Ng, I.T.Lu, *"A Peer-to-peer Zone-based Two-level link state routing for mobile Ad Hoc Networks"*, IEEE Journal on Selected Areas in Communications, Special Issues on Ad-hoc Networks, August 1999

[7] A. Manjeshwar, D.P. Agrawal, TEEN, *"A protocol for enhanced efficiency in wireless sensor networks"* Proceedings of the 1st International Issues in Wireless Networks and Mobile Computing, San Francisco, CA, April 2001

[8] A. Manjeshwar, D.P. Agrawal, APTEEN, *"A hybrid protocol for efficient routing and comprehensive information retrieval in wireless senson networks"* Proceedings of the 2nd International Issues in Wireless Networks and Mobile Computing, Ft. Lauderdale, FL, April 2002

[9] P. Agwarwal and C. Procopiuc, *"Exact and approximation algorithm for clustering"*, in Proc. 9th Annual. ACM-SIAM Symp. Discreet Algorithms, Baltimore, MD, January 1999

[10] Prisacariu V., Cîrciu I., Cioacă C., Boşcoianu M., Luchian A., *Multi aerial system stabilized in altitude for information management*, Review of the Air Force Academy, ISSN 1842-9238; e-ISSN 2069-4733, 3/2014, p89-94