International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2017 IJSRCSEIT | Volume 2 | Issue 3 | ISSN : 2456-3307

Native Hybrid Routing Protocol Named As Zonal-Stable Election Protocol for Heterogeneous Wireless Sensor Networks

Khushboo Yadav

Department of Computer Science, Naraina Group of Institutions, Kanpur, Uttar Pradesh, India

ABSTRACT

Wireless Sensor Networks (WSNs) are comprised of thousands of sensor nodes, with restricted energy, that co-operate to accomplish a sensing task. Various routing Protocols are designed for transmission in WSNs. In this paper, we proposed a hybrid routing protocol: Zonal-Stable Election Protocol (Z-SEP) for heterogeneous WSNs. In this protocol, some nodes transmit data directly to base station while some use clustering technique to send data to base station as in SEP. We implemented Z-SEP and compared it with traditional Low Energy adaptive clustering hierarchy (LEACH) and SEP. Simulation results showed that Z-SEP enhanced the stability period and throughput than existing protocols like LEACH and SEP.

Keywords: Wireless Sensor Networks, Hierarchical routing protocols, Data fusion, Enhanced Stable Election Protocol

I. INTRODUCTION

WSNs consist of a large number of sensor nodes that are deployed randomly to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants at different locations. Advancement in wireless communications, electronics and technological evolution has enabled the development in the field of WSNs due to their low cost and variety of applications such as health, home and military etc. Research is going on to solve different technical issues in various application areas. Sensor nodes consist of components capable of: sensing data, processing data and also communication components to further transmit or receive data. The protocols and algorithms of such networks must possess self-organizing capabilities to ensure accurate and efficient working of the network.

Communication in WSNs occurs in different ways which totally depends on the application. Generally, there are three main types of communication: Clock Driven, Event Driven and Query Driven

In all three types of communication, efficient use of energy is of concern while studying, designing or deploying such networks to prolong the sensing time and overall lifetime of the network.

Hierarchical routing protocols have been proved more energy efficient routing protocols. Several protocols are designed for homogeneous networks. LEACH [1] is one of the first clustered based routing protocol for homogeneous network. LEACH assigns same probability for all nodes to become cluster head. However, LEACH does not perform well in heterogeneous environment. Heterogeneity of nodes with respect to their energy level has also proved extra lifespan for WSNs. To improve efficiency of WSNs, SEP [2] was proposed. SEP is a two level heterogeneous protocol. SEP assigns different probability (to become cluster head) for nodes on the basis of their energy level. However, SEP does not use extra energy of higher level nodes efficiently.

II. BRIEF LITERATURE SURVEY

LEACH [1] is a hierarchical clustering algorithm for judicious usage of energy in the network. LEACH uses randomized rotation of the local cluster head. LEACH performs well in homogeneous environment. In LEACH every node has same probability to become a cluster head. However, LEACH is not well suited for heterogeneous environment. SEP is a two level heterogeneous protocol introducing two types of nodes, normal nodes and advance nodes. Advance nodes have more energy than normal nodes.

In SEP both nodes (normal and advance nodes) have weighted probability to become cluster head. Advance nodes have more chances to become cluster head than normal nodes. SEP does not guarantee efficient deployment of nodes. Enhanced Stable Election Protocol (E-SEP) [3] was proposed for three level hierarchies. ESEP introduced an intermediate node whose energy lies between normal node and advance node. Nodes elect themselves as cluster head on the basis of their energy level. The drawback of ESEP is same as in SEP. Distributed Energy-Efficient Clustering Protocol (DEEC) [4] shows multilevel heterogeneity. In DEEC the cluster head formation is based on residual energy of node and average energy of the network. In DEEC the high energy node has more chance to become cluster head than low energy node. TEEN [5] is reactive protocol for time critical applications. TEEN was proposed for homogeneous network. In TEEN the criteria for selection of cluster head is same as in LEACH, TEEN introduces hard and soft threshold to minimize the number of transmissions thus saving the energy of nodes. In this way the life span and stability period of the network increases.

III. PROBLEM FORMULATION

In SEP normal nodes and advance nodes are deployed randomly. If majority of normal nodes are deployed far away from base station it consumes more energy while transmitting data which results in the shortening of stability period and decrease in throughput. Hence efficiency of SEP decreases. To remove these flaws we divide network field in regions. As corners are most distant areas in the field, where nodes need more energy to transmit data to base station. So normal nodes are placed near the base station and they transmit their data directly to base station. However advance nodes are deplore far away from base station as they hay more energy. If advance nodes transmit data directly to base station more energy consumes, so to save energy of advance nodes clustering technique is used for advance nodes only.

IV. METHODOLOGY

In this section we present our proposed protocol. Our protocol is extension of SEP. It follows hybrid approach i.e. direct transmission and transmission via cluster head. Further we discuss in detail the functioning of our protocol.

In most routing protocols, nodes are deployed randomly in network field and energy of nodes in network is not utilized efficiently. We modified this theme: network field is divided in three zones: zone 0, Head zone 1 and Head zone 2, on the basis of energy levels and Y co-ordinate of network field.

We assume that a fraction of the total nodes are equipped with more energy. Let m be fraction of the total nodes n, which are equipped with α time more energy than the other nodes. We refer these nodes as advance nodes, (1-m)×n are normal nodes.

Proposed Z-SEP uses two techniques to transmit data to base station. Techniques are:

- Direct communication.
- Transmission via Cluster head.

Direct Communication: Nodes in Zone 0 send their data directly to base station. Normal nodes sense environment, gathers data of interest and send it data directly to base station.

Transmission via Cluster head: Nodes in Head zone 1 and Head zone 2 transmit data to base station through clustering algorithm. Cluster head is selected among nodes in Head zone 1 and Head zone 2. Cluster head collect data from member nodes, aggregate it and transmit it to base station. Cluster head selection is most important. As shown in Fig.1 advance nodes are deployed randomly in Head zone 1 and Head zone 2. Cluster is formed only in advance nodes. Assume an optimal number of clusters Kopt and n is the number of advance nodes. According to SEP optimal probability of cluster head is

$$Popt = \frac{Kopt}{n} \qquad (1)$$

Every node decides whether to become cluster head in current round or not. A random number between 0 and 1 is generated for node. If this random number is less than or equal threshold T(n) for node then it is selected as cluster head. Threshold T(n) is given by

$$T(n) = \begin{cases} \dfrac{Popt}{1 - Popt\left(r \times mod \dfrac{1}{Popt}\right)} & if\ n \in G \\ 0 & otherwise \end{cases} \qquad (2)$$

Figure 1 shows the illustrates Z-SEP operation.

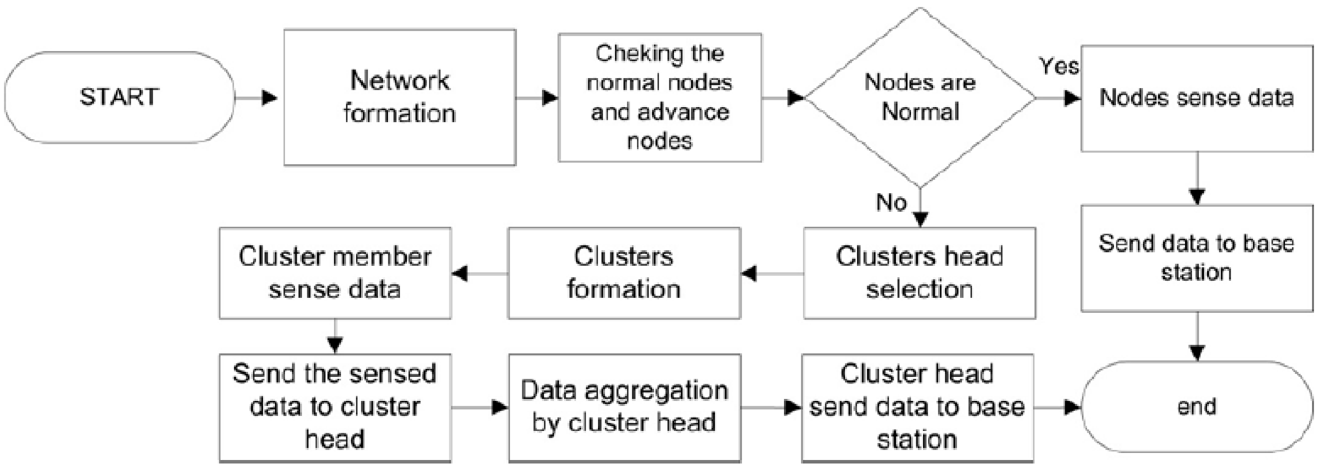

Figure 1. Flow chart of Z-SEP

V. SIMULATIONS

We simulate our proposed protocol in a field with dimensions 100m×100m and 100 nodes deployed in specific zones with respect to their energy. Base station is placed in the center of the network field. We are using the first order radio model as used in SEP. MATLAB is used to implement the simulations.

Specifically, we have following settings.

Let 20% of nodes are advance nodes and half of them are deployed in Head zone 1 and half in Head zone 2.since Popt is 0.1 so we have 2 cluster heads per round. One cluster head in Head zone 1 and one in Head zone 2 per round.

Other simulation parameters are shown in Table 1.

TABLE 1

SIMULATION PARAMETERS

Parameters	Value
Initial energy E_o	0.5 *J*
Initial energy of advance nodes	$E_o(1+a)$
Energy for data aggregation E_{DA}	5 *nJ/bit/signal*
Transmitting and receiving energy E_{elec}	5 *nJ/bit*
Amplification energy for short distance E_{fs}	10 $Pj/bit/m^2$
Amplification energy for long distance E_{amp}	0.013 $pJ/bit/m^4$
Probability P_{opt}	0.1

VI. RESULT

Here, we compare the results of our protocol with SEP and LEACH. We have introduced heterogeneity in LEACH, with the same setting as in our proposed protocol, so as to access the performance of all the protocol in presence of heterogeneity. Our goals in conducting simulation are

- To examine the stability period of LEACH, SEP and Z-SEP.
- We also examine the throughput of LEACH, SEP and Z-SEP.

Fig. 5 and Fig. 6 shows result for the case when m=0.2 and α=1.This means that there are 20 advance nodes out of total nodes which are 100. According to our proposed protocol 10 advance nodes will be deployed randomly in Head zone 1 and 10 advance nodes will be placed in Head zone 2.

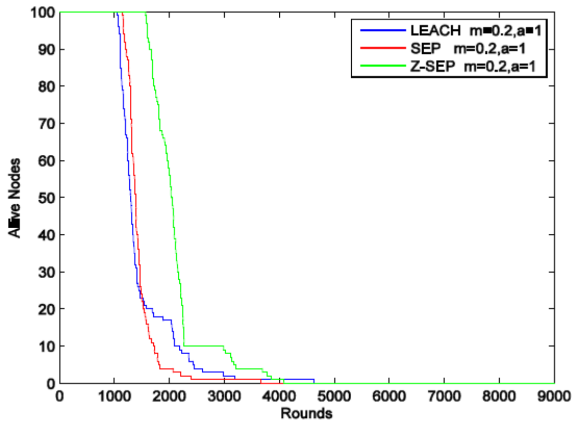

Figure 5. Alive nodes in LEACH, SEP and Z-SEP

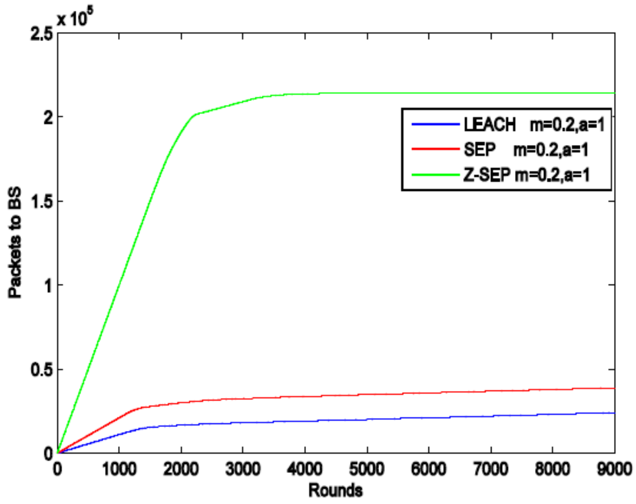

Figure 3. Throughput of LEACH, SEP and Z-SEP

VII. CONCLUSION

In this paper, we proposed Z-SEP for heterogeneous environment: two level heterogeneity. The field is divided in to three zones: Zone 0, Head Zone 1 and Head Zone 2. Normal nodes are only deployed in zone 0 to reduce the energy consumption and they transmit data directly to base station. Half of advanced nodes are deployed in Head zone 1 and half in Head zone 2 and they use clustering technique to transmit data to base station. Results have shown that the stability period is increased approximately 50%, by just altering the deployment of the different type of nodes in different zones according to their energy requirement. Throughput of Z-SEP is also increased compared with LEACH and SEP.

VIII. REFERENCES

[1] Heinzelman, W. R., Chandrakasan, A., & Balakrishnan, H. (2000, January). Energy-efficient communication protocol for wireless microsensor networks. In System Sciences, 2000. Proceedings of the 33rd Annual Hawaii International Conference on (pp. 10-pp). IEEE.

[2] Smaragdakis, G., Matta, I., & Bestavros, A. (2004). SEP: A stable election protocol for clustered heterogeneous wireless sensor networks. Boston University Computer Science Department.

[3] Aderohunmu, F. A., & Deng, J. D. (2009). An Enhanced Stable Election Protocol (SEP) for Clustered Heterogeneous WSN (No. 2009/07). Discussion Paper Series.

[4] Qing, L., Zhu, Q., & Wang, M. (2006). Design of a distributed energy-efficient clustering algorithm for heterogeneous wireless sensor networks. Computer communications, 29(12), 2230-2237.

[5] Manjeshwar, A., & Agrawal, D. P. (2001, April). TEEN: a routing protocol for enhanced efficiency in wireless sensor networks. In 1st International Workshop on Parallel and Distributed Computing Issues in Wireless Networks and Mobile Computing (Vol. 22)..

[6] Akyildiz, I. F., Su, W., Sankarasubramaniam, Y., & Cayirci, E. (2002). Wireless sensor networks: a survey. Computer networks, 38(4), 393-422.

[7] Abbasi, A. A., & Younis, M. (2007). A survey on clustering algorithms for wireless sensor networks. Computer communications, 30(14), 2826-2841.