Impact of Fix Cluster Head Selection (FCHS) Routing Protocol for Wireless Sensors Network

Priyanka Chugh Shivanka and Ashwani Kumar

Abstract Today main objective of wsn is to minimize the energy dissipation for the whole network. Clustering is one of the most knows methods widely used to face these challenges. Fix Cluster Head Selection (FCHS) routing protocol analyses how the system lifetime is improved by fixing the selection of clusters head. In this paper a cluster based communication protocol with considering the low energy consumption in wireless sensor networks, is introduced which balanced the energy load among the sensor node. Fix Cluster Head Selection (FCHS) analyses the cluster head selection to find the optimal probability of becoming a cluster head. Simulation result of FCHS corresponding to LEACH in mat lab shows that these designs increase the lifetime of the network 105 %. We found that FCHS yield longer stability region for higher values of extra energy brought by more powerful nodes. Finally, LEACH protocol and the improved algorithm simulate in MATLAB, and make Performance analysis and comparison in number of nodes alive, total energy consumption in network and a round of node death distribution. The results show that, FCHS compared with LEACH protocol, the improved algorithm prolongs the network life cycle, raises energy utilization and has good load balance.

Keywords Fix cluster head selection FCHS · Wireless sensor network · LEACH · Energy dissipation · Routing protocol

P. C. Shivanka (✉)
CSE, MMU University, Ambala, India
e-mail: shivankachugh84@gmail.com

A. Kumar
EE, Lingaya's University, Faridabad, India
e-mail: ashwani_smash@yahoo.co.in

N. Chaki et al. (eds.), *Computer Networks & Communications (NetCom)*,
Lecture Notes in Electrical Engineering 131, DOI: 10.1007/978-1-4614-6154-8_76,

1 Introduction

A sensor network is composed of a large no of sensor nodes, which are densely deployed either inside the phenomenon or very close to it. The no of nodes in sensor network can be several orders of magnitude higher than the nodes in an ad hoc network. Sensor network are densely deployed [9]. This tiny system, which consist of sensing, data processing and communication components are known as wireless sensor network [6].Sensor nodes are limited to power, computational capacities and memory. Sensor nodes mainly use broadcast, most ad hoc network are based on Point to Point. These nodes, with limited computing, communicating, and sensing capabilities as well as Limited energy can make the best use of themselves together data from sensor node to Base Station (BS) by using excellent network topologies, optimized routing scheme [8]. In simplest method these node get data from sensor to BS by using topology, the energy loss in LEACH is more than the Fix Cluster Head Selection (FCHS). WSN has limited supply of energy hence an energy conserving routing protocol is important for these networks. Therefore, while conventional network aim to achieve high quality of service provisions, sensor network focus primarily on power consumption. There are several power-aware routing protocol explained in the literature [2, 7, 8, 10]. Although the clustering can reduce the energy consumption, the main problem is that the energy consumption is concentrated on the cluster heads. In order to overcome this demerit, the issue in cluster routing is how to distribute the energy consumption. The representative solution is LEACH [3] which is a localized clustering method based on the probability model. All sensor nodes evenly elect itself as a cluster head based on the probability model to distribute the energy consumption. However, in some cases, in-efficient cluster heads can be elected. Because LEACH is only depend on probability model, some cluster heads may be very close each other and can be located in the edge of the WSNs. These in-efficient cluster heads could not maximize the energy efficiency [4]. Recently, Gupta [4] introduced a cluster head election method using fuzzy logic to overcome the defects of LEACH.

2 FCHS Algorithm Details

The FCHS was created with particular criteria such as Fixed cluster head selection, fixed location of sensor node that will cause less energy dissipation of cluster head and base station so that the protocol becomes computational simple as the static route could be used. FCHS is source initiates protocol with time driven reporting, so the sensor node would always have data to send to the base station. FCHS would also apply data aggregation to avoid information overload or access of data, in this aspect FCHS shares the same features as LEACH [5]. FCHS shows an analytic architecture for obtaining the stable probability with which a node would become a cluster head in order to minimize the network's energy consumption. The analysis

presented for a small network. FCHS change the choice of cluster head over time for minimum energy dissipation between the threshold level 0 and 1 to become clusters head (Table 1).

2.1 Proposed Fchs Algorithm for Cluster Head

Step1: Initialization
Cluster head change over time for minimum energy dissipation Decision is made by random number between 0 and 1 node become Cluster Head.
p = percentage of cluster head.
r = current round.

Step2: Header Selection

- If the number is less than the following threshold:
- if(temp_rand< = (p/(1- p*mod(r,round(1/p))))
- if(countCHs< = 5)
- countCHs = countCHs + 1;

Step 3: Advertisement

- After the selection of Cluster Head choose in between the threshold
- The node broadcast a CHs_ADV advertisement to normal node.
- Formation and function of Cluster head.
- Next round is executed until rmax value.

Step 4: Management

- Member nodes of each cluster send data to CHs.
- CHs collects the data
- CHs send the collected data to the BS.

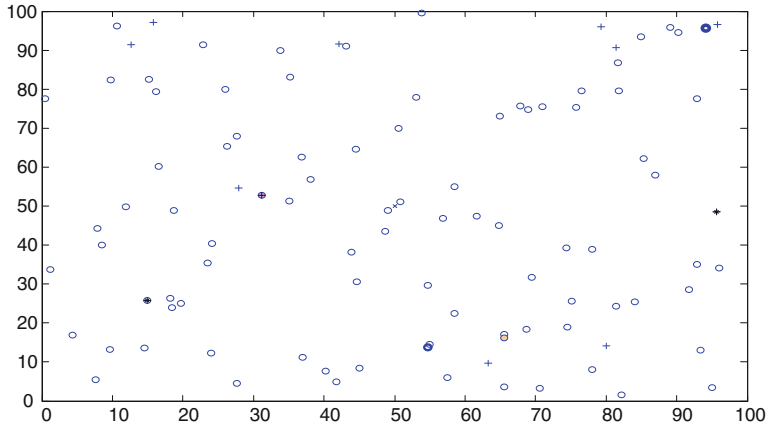
Step5: Header Switch

- If E(CH)<E', the node become a header
- If E of the node greater than E', go to step2 total energy of the network
- Remaining_Energy = 0;
- Total_Energy = n*((1-m)*Eo+m*(1+a)*Eo);
- for i = 1:n
- Remaining_Energy = Remaining_Energy + S(i).E;
- end
- Energy_Consumed = Total_Energy-Remaining_Energy;

Table 1 System lifetime using different amounts of initial energy for the sensors

Initial energy (J/node)	Protocol	Probability of Cluster head	Rounds first node dies	Round last node dies
0.1	FCHS	CH = 4	105	2113
		CH = 5	135	3113
		CH = 7	167	1576
		CH = 10	184	904
	LEACH	CH = 4	96	612
		CH = 5	123	637
		CH = 7	180	579
		CH = 10	177	737
0.25	FCHS	CH = 4	412	2005
		CH = 5	462	3430
		CH = 7	485	2085
		CH = 10	495	2571
	LEACH	CH = 4	275	2071
		CH = 5	353	1295
		CH = 7	413	1395
		CH = 10	492	2549
0.5	FCHS	CH = 4	541	2768
		CH = 5	645	3583
		CH = 7	740	3958
		CH = 10	853	3972
	LEACH	CH = 4	603	2846
		CH = 5	595	3000
		CH = 7	835	2590
		CH = 10	948	3000
1	FCHS	CH = 4	1681	10000
		CH = 5	1730	10000
		CH = 7	1932	8621
		CH = 10	2019	4643
	LEACH	CH = 4	1262	4197
		CH = 5	1200	4014
		CH = 7	1536	7000
		CH = 10	1923	9000

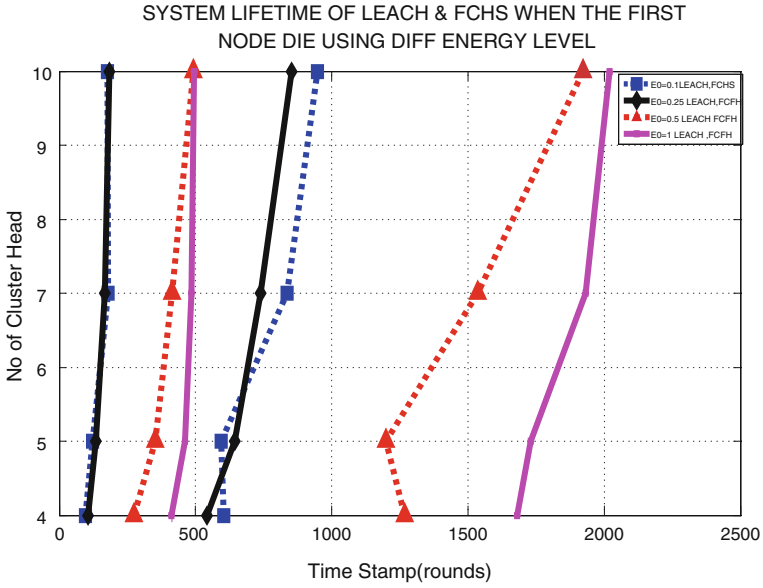
2.2 Simulation Results for FCHS and LEACH



3 Comparison of FCHS and LEACH When the First Node Dies

Performance graph of System lifetime when the *First node die* using Different Energy Level with fixing no of cluster head shows the comparison of the FCHS and LEACH Initially, when clusters are being created, each node decides whether or not to become a cluster-head based on the suggested percentage of cluster heads for the network (determined a priori) and here in this graph Dotted (---) line shows when the first node of LEACH gets die shows the life time of the network system the number of times the node has been a cluster-head so far. This decision is made by the node n choosing a random number between 0 and 1. If the number is less than a threshold T(n)[1], the node becomes a cluster-head for the current round. The threshold is set as:

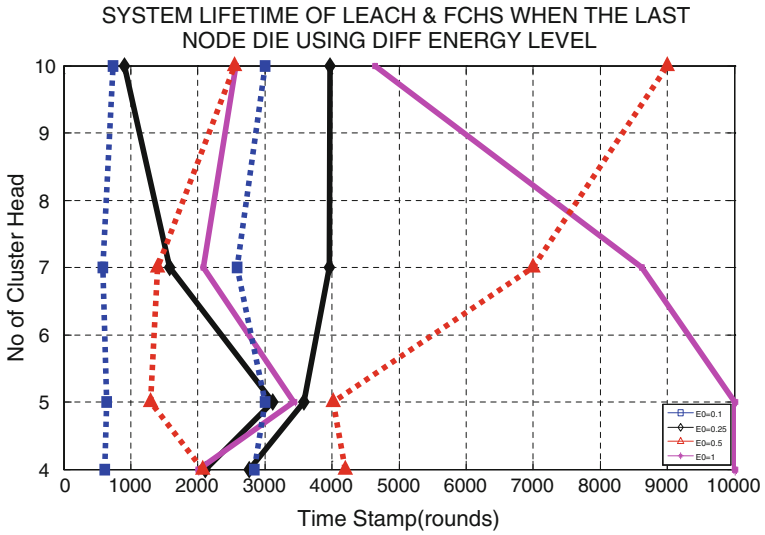
$$T(n) = \begin{cases} \dfrac{p}{1 - P * (r mod \frac{1}{P})} & \text{if } n \in G \\ 0 & \text{otherwise} \end{cases}$$



Where P = the desired percentage of cluster heads (e.g., P = 0.10), r = the current round, and G is the set of nodes that have not been cluster-heads in the last 1/P rounds. Using this threshold, each node will be a cluster-head at some point within 1/P rounds. During round 0 (r = 0), each node has a Clustering and Cluster-Head Selection Techniques used in WSN probability P of becoming a cluster-head. In the graph the *rigid line* shows the lifetime of the cluster head in the FCHS. Hence, the FCHS *increase the lifetime of the network* by fixing the choice of cluster head.

3.1 Comparison of FCHS and LEACH When the Last Node Dies

Performance graph of System lifetime when the *Last node die* using Different Energy Level with fixing no of cluster head shows the comparison of the FCHS and LEACH Here in this graph Dotted (----) line shows when the Last node of LEACH gets die shows the life time of the network system the number of times the node has been a cluster-head so far. In the graph the rigid line shows the life-time of the cluster head in the FCHS. Hence, the FCHS increase the lifetime of the network by fixing the choice of cluster head by increase the value by 1000 rmax [4].



4 Conclusions

In WSN power efficiency is an important performance metrics that must be considered when designing the routing protocol. Objective of this paper is to design an energy aware routing protocol based on LEACH. Wireless Sensor networks (WSN) have emerged as a promising tool for monitoring (and possibly actuating) the physical world, we also compared the routing protocols according to different parameters since one single Routing protocol is not applicable in all the situations. We have performed detailed analysis of the LEACH protocol and the Direct Communication Protocol by running the simulations in MATLAB and by fixing the no of cluster head it enhanced the System Life time also the less energy dissipation. We have found that the LEACH protocol outperforms the Direct Communication Protocol in terms of Energy Dissipation. To form constant number of clusters Results show that FCHS is an efficient routing protocol when compared to conventional routing protocol LEACH, which has shown less lifespan of network. Simulation results show that FCHS reduces communication energy by as much as 105 % compared to LEACH. This is due to the fix cluster head selection, which results in optimal probability of becoming a cluster head. It could be concluded that an effective selection of a cluster head could reduce the usage of consumption power. Simulation also shows by minimizing the transmission distance of FCHS and LEACH would result in increase the lifetime of the network.

References

1. Akkaya K, Younis M (2005) A survey on routing protocol for wireless sensor networks. Elsevier Ad Hoc J 3(3):325–349
2. Akyildiz IF, Su W, Sankarasubramaniam Y, Cayirci E (2002) A survey on wireless sensor networks. IEEE Commun Mag 40(8):102–114
3. Chandrakasan A, Balakrishnan H (2000) Energy efficient communication protocol for wireless sensor networks. In: Proceedings of the 33rd hawaii international conference on system science, January 2000
4. Gupta I, Riordan D, Sampalli S (2005) Cluster-head election using fuzzy logic for wireless sensor networks. In: Communication networks and services research conference, Halifax, 255–260 May 2005
5. Ibriq J, Mahgoub I (2004) Cluster based routing in wireless sensor networks:issues and challenges. In: Proceedings of the 2004 symposium on performance evaluation of computer telecommunications System, USA, 759–766 July 2004
6. Ilays M (2004) Imam Mahgoub, handbook of sensor networks: compact wireless and wired sensing systems. CRC Press, Boca Raton, USA
7. Jiang Q, Manivann D (2004) Routing protocols for sensor networks. In: Proceedings of the 1st IEEE consumer communications and networking conference, Las Vegas, USA, 93–98 January 2004
8. Kim HS, Han KJ (2005) A power efficient routing protocol based on balanced tree in the WSN. In: Proceedings of the 1st international conference on distributed framework for multimedia applications, 138–143 February 2005
9. Norsyafizan W, Muhamad W, Dimyati K, Mohamad R (March 2010) Abd Kadir R, Heinzelman WR (2010) Evaluation of stable cluster head election (SCHE). In: Routing protocol for wireless sensor networks
10. Selvakennedy S (2006) An energy efficient clustering algorithm for multihop data gathering in wireless sensor networks. J Comput 1(1):40–47