International Journal of Research in Advent Technology, Vol.2, No.12, December2014
E-ISSN: 2321-9637

A Survey on Hierarchical Routing Protocols for Wireless Sensor Network

Dr. V. Venkatesa Kumar[1], R. Sathya Suruthy[2], Dr. M. Newlin Rajkumar[3]
Department of computer science and engineering[1, 2, 3], Anna university regional center[1, 2, 3], Coimbatore, Tamil Nadu, India[1, 2, 3]
Email: sathyasuruthy@gmail.com[2]

ABSTRACT-Wireless Sensor Networks consists of few to large number of nodes where each node is connected with a sensor which is known as sensor nodes. A sensor node in WSN is capable of gathering information and communicating with other nodes connected in networks. Sensor nodes are also used to transmit the sensed data effectively between the connected nodes in wsn. Due to limited number of energy in sensor nodes data transmission is not effective. Some kind of routing protocols are used to transmit data effectively and to balance the energy. There are various routing protocols like LEACH, DWEHC, HEED, EEUC, EEHC, PANEL, UCS, EECS, etc., are used to balance energy of sensor nodes. In this paper, the focus is mainly over the study of hierarchical based routing protocols for wireless sensor networks which prolongs the network lifetime of wsn.

Index Terms- Wireless Sensor Networks, Energy balance, Cluster Head, Network Lifetime**.**

1. INTRODUCTION

The Wireless Sensor Network (WSN) is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Energy Balancing is main challenge faced by wireless sensor network. It is very complex in WSN due to the nature of sensor nodes which works on battery powered devices contains less number of energy. Due to limited number of energy in nodes a routing protocols are used to balance energy. The main characteristics of WSN include power consumption for nodes such as ability to overcome node failures, mobility of nodes, ability to adapt with environmental conditions and ease of use

Some applications of WSN are as follows:

- Process Management
- Health care monitoring
- Air pollution monitoring
- Forest fire detection
- Landslide detection
- Water quality monitoring

Wireless Sensor Networks deals a main drawback of energy loss. Some types of routing protocols are used to overcome the drawback of energy loss in wsn. By implementing such protocols energy efficiency is gained and performed with less amount of energy loss which helps to send packets between nodes for communication. Routing protocols extends the network lifetime.

2. RELATED WORK

This paper contains the study of some different routing protocols available in wireless sensor networks. A routing protocol is a set of rules which is used by routers to determine the paths between nodes to which they should forward packets towards its destinations. Routing protocols are based on two types such as protocol operation and network structure. In this paper, hierarchical based routing protocols are discussed.

2.1. *Leach*

LEACH stands for Low Energy Adaptive Clustering Hierarchy which is developed for sensor nodes which are used to monitor the communication between the nodes. LEACH protocol is the first type of hierarchical routing protocols. The data packets from the each individual node must be sent to a central base station, which it is located far from the sensor networks, through which the user can access the data. There are several properties for protocols on these types of networks that can use 100's - 1000's of nodes, maximize the system lifetime, maximize network coverage and to use uniform, battery-operated nodes

The LEACH Network is considered to be a dynamic clustering method. This network is made up of number of nodes and some nodes are said to be cluster head in its sensor networks. LEACH is said to be dynamic because the cluster head is randomly selected according to the energy of nodes. The basic method of LEACH is based on two steps. They are

1. *Setup phase:* Based on cluster head selection and cluster formation.
2. *Steady-state phase:* Based on collection of data and delivering the data to base station.

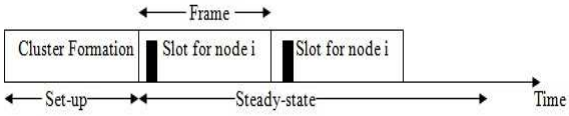

Fig.1 LEACH Protocol phases.

LEACH protocol is self-organized and self adaptive. LEACH uses each round as unit. Each round is maintained for reducing unnecessary energy lost due to data transmission. The cluster head is selected from a set of nodes in the basis of energy of each node. A cluster head change for each round according to its energy efficiency .In LEACH protocol cluster heads is not only responsible for communication between nodes and base station. It also responsible for data fusing .The following figure represents about the LEACH protocol cluster formation

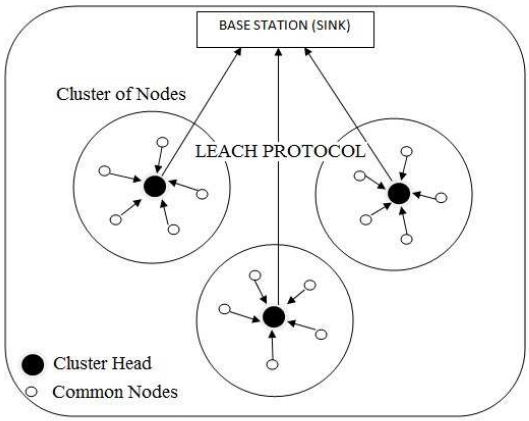

Fig.2 LEACH Protocol cluster formation

2.2. *Eeuc*

EEUC is defined as Energy-Efficient Unequal Clustering protocol. EEUC is strongly based on distributed unequal clustering algorithm where cluster-heads are elected based on the high residual energy of its neighbor and its distance to the base station (BS).To address the difficult problem, EEUC divide the nodes into the cluster with unequal size, and cluster closer to the base station have smaller sizes that those father away from the BS because the node could not communicate directly to the BS due to the limited transmission range. Each node is assigned by competitive range. This competitive range decreases distance to the base station. This result is that the clusters closer to the base station are smaller in size thus the CH will consume less energy during intra-cluster communication and can preserve more energy for inter-cluster communication.

EEUC algorithm is also used as an clustering algorithm, because when each cluster round is created, each node generates a random number between 0's and 1's to decide which node is going to participate in the cluster-head selection or not. If a sensor node has decided to join to the cluster head selection process, then it becomes a tentative cluster head. Tentative cluster head in local regions participate in order to become an actual cluster head. This selection is based on the residual energy of each tentative cluster-head. After cluster-head election is done, the remaining sensor nodes join to the closest cluster.

The mechanism of EEUC is, in the network

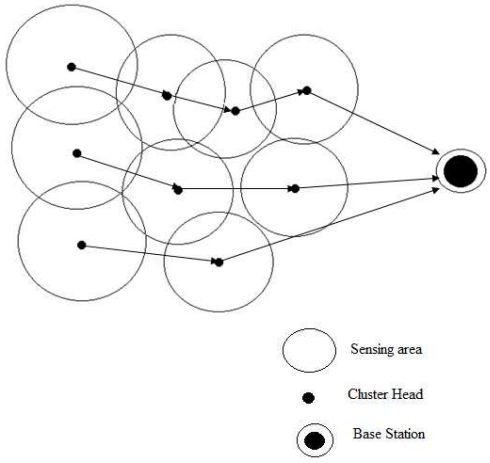

Fig.3 Overview EEUC Mechanism

formation stage, the base station broadcasts a “hello” message to all nodes at a specific power level. By using this way each node can calculate the approximate distance to the base station based on the received signal strength from the nodes. It not alone helps the nodes to select correct power level to communicate with the base station, but also helps us to produce clusters of nodes in unequal size. An overview of the EEUC mechanism follows as shown in the fig3 , where the circles of unequal size represents the clusters of nodes in unequal size and the traffic among cluster heads illustrates the multihop forwarding method.

2.3. *Eecs*

An EECS stand for Energy Efficient Clustering Scheme (EECS) is developed for network lifetime based on clustering algorithm. In which cluster heads challenge for the ability to raise to cluster head for a given round. This competition involves candidates broadcasting their residual energy to nearby candidates. If a given node does not find a node with high residual energy, then that node becomes a cluster head. Cluster formation is different than that of LEACH. LEACH forms clusters based on the least distance of nodes to their corresponding cluster head. EECS extends this algorithm by dynamic sizing of clusters based on cluster distance from the base station. By using this algorithm it results to addresses the problem that which clusters are at a higher range

from the base station requires more energy for communicating with closer.

This algorithm ultimately improves the distribution of energy throughout the network, occurs in better resource usage and extended network life time. EECS is a LEACH-like clustering strategy, where the network is partitioned into a set of clusters with one cluster head in each cluster group. Transmission between cluster head and BS is direct .In the network deployment phase, the BS broadcasts a "hello" message to all the nodes at a definite power level. By this way each node can compute the approximate distance to the BS based on the received signal strength. It helps nodes to select the proper power level to communicate with the BS. Also this distance is used to balance the load among cluster heads. In cluster head election phase, well distributed cluster heads are elected with a little control towards it. And In cluster development phase, a weighted function is introduced to form load balanced clusters.

2.4. *Heed*

HEED is known as a Hybrid Energy-Efficient Distributed Clustering based on multi-hop clustering algorithm for wireless sensor networks. It focuses on efficient clustering by proper selection of cluster heads based on the physical distance between nodes.

The main objectives of HEED:

- Distributes energy consumption to extend network lifetime
- Minimize the energy during cluster head selection phase
- Minimize the control towards the network.

In HEED it is important to identify the range of a node in terms of its power levels as required node will have multiple discrete transmission power levels. The power level used by a node for intra-cluster transmissions and during the time of clustering is referred as cluster power level. Low cluster power levels develop an increase in spatial reuse while high cluster power levels are required for intra-cluster transmission as they span two or more cluster areas.

The most important features of HEED are the method of cluster head selection. Cluster heads are determined based on two important parameters:

1. The residual energy of each node is used to choose the initial set of cluster heads. This is commonly used in many other clustering methods.
2. Intra-Cluster transmission cost is used by nodes to determine the cluster to join. This is especially useful if a required node falls within the range of more than one cluster head.

Therefore, when selecting a cluster, a node will communicate with the cluster head that yields the lowest intra-cluster transmission cost. The intra-cluster transmission cost is measured using the Average Minimum Reachability Power (AMRP) measurement. The AMRP is the average of all minimum power levels required for each node within a cluster range R to communicate effectively with the cluster head. The AMRP of a node i then become a measure of the expected intra-cluster communication energy if this node is elevated to cluster head. Utilizing AMRP as a second parameter in cluster head selection is more efficient then a node selecting the nearest cluster head

3. Conclusion

Hierarchical based routing protocols are said to be as one of the most efficient routing protocols in Wireless Sensor Networks (WSN) due to its higher energy efficiency, network scalability, and lower data retransmission. In this paper we have take a survey of the current state of proposed hierarchical routing protocols, specifically with respect to their power and reliability necessity. In wireless sensor networks, the energy limitations of nodes play a critical role in designing any protocol for implementation. Finally, we summarize hierarchical based routing protocols covered in this survey stating their strengths to extend the network lifetime.

REFERENCES

[1] Degan Zhang, Guang Li, e Zheng,Xuechao Ming, and Zhao-Hua Pan, An Energy-Balanced Routing Method Based on Forward-Aware Factor for Wireless Sensor Networks IEEE transactions on industrial informatics, vol. 10, no. 1, February 2014

[2] Yick, J.; Mukherjee, B.; Ghosal D.: Wireless sensor network survey. Computer Networks. Vol. 52, Issue 12, pp. 2292-2330 (2008).

[3] Chong, C.; Kumar, S.: Sensor networks: Evolution, opportunities, and challenges. Proceedings of the IEEE, vol. 91, no. 8, pp. 1247–1256 (2003).

[4] Heidemann, J.; Silva, F.; Intanagonwiwat, C.; Govindan, R.; Estrin, D.; and Ganesan, D.: Building efficient wireless sensor networks with low-level naming. SIGOPS Oper. Syst. Rev., 35, pp.146–159 (2001).

[5] Heinzelman, W.; Chandrakasan A.; and Balakrishnan,H.:Energy-efficient communication protocol for wireless sensor networks. In: Proceeding of the Hawaii International Conference System Sciences, Hawaii (January 2000).

[6] Yu, L.; Wei, L; Zhenhua, K.: Study on Energy Efficient

[7] Hierarchical Routing Protocols of Wireless Sensor Network. WASE International Conference on Information Engineering, ICIE'09. Vol. 1, 10-11 July 2009, pp. 325–328 (2009).
[8] Nazir, B.; Hasbullah, H.: Energy Balanced Clustering in Wireless Sensor Network. IEEE International Conference on Information Technology, (2010).
[9] Zhang, Q.; QU, W.: Energy Efficient Clustering Approach in Wireless Sensor Networks. International IEEE conference on Computer Science and Electronics Engineering, pp. 541-544 (2012).
[10] Li, L.; Wu, H.; Chen, P.: Discuss in Round Rotation Policy of Hierarchical Route in Wireless Sensor Networks. Proceedings of the International Conference on Wireless Communications, Networking and Mobile Computing (WiCOM 2006). pp. 1–5 (Sep. 2006)