ISSN: 2278 – 1323
International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)
Volume 5, Issue 10, October 2016

Evaluation of Equalized Cluster Selection Routing Protocol in Wireless Sensor Network

SANGEETA VHATKAR, SAMREEN SHAIKH, MOHAMMAD ATIQUE

***Abstract*— Wireless Sensor Network is a type of wireless networking in which various sensors deployed in an environment or field where human involvement is not possible or difficult. In WSN all the sensors works in coordination to monitor and control the environment. To perform this WSN requires a efficient routing protocol. In this paper the Equalized Cluster Selection routing protocol in wireless Sensor Network called as ECHERP (Equalized Cluster Head Election Routing Protocol) is presented. In this Protocol BS uses a Gaussian Elimination algorithm which selects the nodes to be a CH in network. It increases the network lifetime by using the balanced clustering. In this paper simulation result has been discussed by using NS-2 Simulator for 100 nodes and QoS parameter like Delay, Throughput, Packet Drop Ratio and Energy Consumption has been derived to evaluate the performance of Protocol.**

***Index Terms*—WSN, QoS, ECHERP, Hierarchical, LEACH, PEGASIS**

I. INTRODUCTION

Sensor based devices, are the futures demand, Now a day, sensors are found everywhere like in automobile , smart phones in industries to control dangerous gases, used in ground soil to control and monitor the soil conditions. A Wireless Sensor Network is normally known a collection of nodes deployed over a field which forms network in which nodes cooperatively work together to sense and control the environment. The development of WSNs was enthused by military applications, particularly surveillance in conflict zones. Today, WSN comprise of sensor embed devices that use sensors to monitor the physical circumstances which can be further extend the application to industrial application, automation process, health monitoring, traffic monitoring, and many consumer areas.

In WSN, abundant sensor nodes which made up of different components required for communication deployed randomly within an application environment where nodes form a network through various self-organization techniques. Sensor nodes monitor the application environment's physical parameter and transmit data to the BS along sensor nodes via hopping.

In WSN, nodes are made-up of various components like Sensing and actuators whose primary responsibility is to monitor the environment using sensors, it also consist of analog to digital convertor to convert the signal received from sensor to digital format which can be used by processing component to process and store the sensed data[10]. Nodes also consist of radio transceiver with receiver and transmitter antenna. The power for each sensor node is derived from a battery or sometime it is supported by solar system.

In a network nodes are made up of components of limited capability, less processing capability, less storage and less battery life [1]. Whereas nodes are normally deployed in a region where human interaction is inconvenient or replacing dead component or node is difficult. In order to get the maximum network life usage of node's capability or resources like power consumption should be minimum. Due to its restrictions in the processing power and limited battery power, the routing protocols designed for the wired networks cannot be used here. Several routing protocol has been proposed to increase the network lifetime of WSN by minimizing the energy consumption [2]. WSN routing protocols are categorized based on network structure used or Protocol operation as shown in Figure 1.

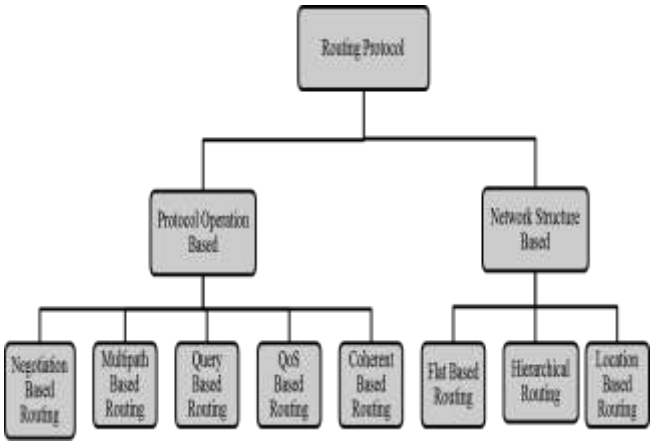

Figure 1 Classification of Hierarchical Routing protocol

Among all these categories of routing protocol hierarchical routing protocol proved as Energy Efficient Routing technique for Wireless Sensor networks [3]. In hierarchical routing protocol nodes are grouped to form a cluster and in each cluster one member is selected as Cluster head (CH). In this type of routing structure Cluster member transmit their sensed data to the CH whereas CH perform the data aggregation and transmit the aggregated data to BS via multiple hopping. Cluster formation and CH selection is normally rely on the nodes energy and sensing region i.e. nodes distance with the CH. Hierarchical routing protocols are also categorized into various types based on the topology

used [4] or method they used for cluster formation or CH selection as shown in Figure 2.

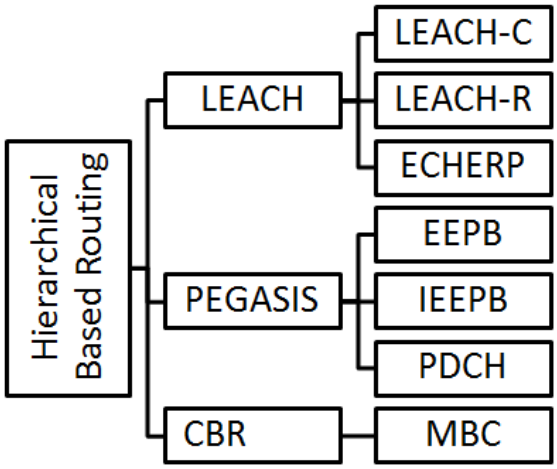

Figure 2 Hierarchical Routing protocols

In this paper our concern is to present LEACH [1,5] and its variant ECHERP [6].

II. LEACH (Low-Energy Adaptive Clustering Hierarchy)

The first routing protocol designed under hierarchical routing method is LEACH [1,5]. As described by hierarchical technique, Nodes under this protocol randomly organize itself to form a cluster and then in each cluster CH will be selected based on residual energy which will perform the data fusion to transmit the data from local Cluster Member to the BS via intermediate nodes. LEACH protocol use randomization technique to distribute the energy load between all the member nodes. The key features of LEACH are:

- Localized coordination and control for cluster set-up and operation.
- Rotation of CH role among different nodes
- Local compression to reduce global communication.

The use of CH for transmitting data to the base station powers the advantages of small transmit distances, which requires only a CH to transmit long distances to the base station. Sensors can pick themselves to be cluster-heads at any given time based on some probability. After Selecting the CH, nodes will broadcast their identity to all the other nodes wherein each node will decide based on minimum distance to which cluster it want to belong by selecting the CH.

The operation of LEACH protocol is divided into different rounds, where each round starts with a set-up phase, in which nodes organized to form the clusters, followed by a steady-state phase, where data transmission to the base station initiate[13]. In order to minimize overhead, the duration of steady-state phase is lengthy compared to the set-up phase. The Cluster formation in LEACH protocol is shown in Figure 3. Instead of energy efficient protocol LEACH has several drawbacks as follows:

- Leach is unstable during the setup phase because of non-deterministic time duration for setup phase.
- This protocol is not suitable for networks that are used in large region as it uses single hop routing where each node can transmit directly to the cluster head and the sink.
- The CHs used in the LEACH will consume a great amount of energy if they are situated far away from the BS.
- Leach does not guarantee good cluster head distribution and it involves the assumption of uniform energy consumption for the cluster heads.
- Leach based dynamic clustering which ends with extra overhead

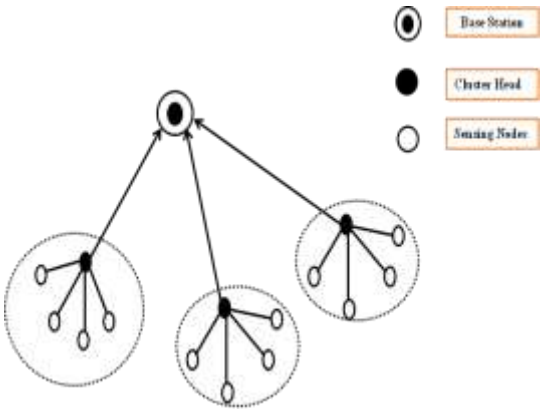

Figure 3 Cluster Formations of LEACH

To overcome the problem of LEACH various protocols has been developed like LEACH-C [1,5,12], LECH-R[7], Multilevel LEACH[11], BEC-LEAC[8], ECHERP[6]. All these mentioned LEACH based Protocols uses different cluster formation of CH selection methods. LEACH-R(Relay) protocol uses Relay node between CH and BS to reduce the distance to be traveled by CH to the BS in case of larger region network. BEC-LEACH (Balancing Energy Consumption LEACH) overcome the problem of LEACH of unevenly distributing the CHs within a network by considering remaining energy and geographical location of nodes as primary factor to be chosen as CH. It checks the distance between BS and CH and incase distance is larger than protocol adds the auxiliary node between BS and CH. PSO-HC[9] protocol uses particle swarm optimization technique to select CH which outperform various cluster based routing protocol in terms of energy efficiency and throughput. Whereas ECHERP uses different method of CH selection to balance the network lifetime.

III. ECHERP protocol

In this section, we have discussed ECHERP routing protocol for WSN. Under this section we will first discuss the network model used and then protocol description and its implementation.

A. Network model

An "N" number of nodes randomly deployed within a network region or area and it is assumed that all the nodes are static or immovable. Initially all the sensor nodes will

be charged with same amount of energy. Communication will be bidirectional. The communication and Processing capabilities are equal for nodes. The sensor nodes are unaware of their location.

B. Protocol description

Same as LEACH protocol, ECHERP protocol also forms the cluster within a network and within each Cluster it selects one node as CH which is used to aggregates the data from the CM. But the difference is that it uses multiple hops to transmit data to BS from CH to overcome the problem of longer distance to be travelled by CH to transmit the data to BS which uses lots of energy. Also this protocol uses a Gaussian Elimination Algorithm to select node to be a CH within a network and the number of time it can be cluster method, because of this method it reduces the energy consumption.

C. Implementation of ECHERP

There are various hierarchical routing protocols which are known for clustering, out of which we have studied ECHERP. The implementation phases are as follows.

- Network Deployment
- Setup Phase
- Data Transmission phase

Network Deployment

The network has 1000m × 1000m network area in which 100 nodes scenario is closely deployed. A fixed BS is located away from the sensor field. The sensor nodes are energy constrained with uniform initial energy distribution. Each node performs the environment sensing at a fixed rate. The sensor nodes are assumed to be immobile. However, the protocol can also support node mobility. All the nodes have the same computing and communication capacity. The sensors have the same physical characteristics, the same energy capacity and the same transmission range at the time of network deployment. Nodes are created for sending and receiving the data packets.

Setup Phase

In this phase each node broadcasts a Hello message to publicize its energy level and location to its neighbours whereas same time each and every node maintain a neighbour information table that stores the energy level and the positions of its neighbours and its own corresponding information sends this next neighbour. BS collects the information related all the nodes. Once BS receives the information of all the nodes then it will start CH selection procedure. At this point, all the nodes are CH candidates.

During the CH selection procedure BS select CHs for a network and also computes the number of rounds at which every node can be a CH. During this process BS chooses the few nodes closest to itself to be the high level cluster heads, also some of the nodes from which the BS has not received any direct message as a low level CHs. After selecting the CHs the BS broadcasts the unique IDs of the selected nodes, and their cluster members and the nodes use this information to form a cluster.

Data Transmission Phase

In this phase each sensor nodes start sending their sensed events or data to their local CHs and CH fuses the data received from CM to reduce the amount data to be transmitted to BS. Then every lower level cluster head collects the data from CM , aggregates the data and then transmits the fused data to the higher lever cluster heads from example 4th level CH send the fused data to 3rd level CH, until the data reaches the BS.

IV. Simulation And Result Analysis

In this section, we have performed the evaluation of the performance of our proposed hierarchical clustering protocol based on QoS parameter through simulation results.
Table 1 show the value assigned to different network parameters.

Table 1 Network Model

Parameters	Value
Network Area	1000 × 1000 m2
Sensor Nodes	100
Node Sensing Range	250 meter
Data Rate	512 kbps
Initial Energy	100 J
Transmission Power	0.9 J
Receiving Power	0.8 J
Sensing Power	0.0175 J

The QoS parameter used here to compare the performance of proposed protocol are Delay, Energy Consumption, Throughput, and Packet Loss Ratio. These are key performance indicator for various routing protocols in WSN.

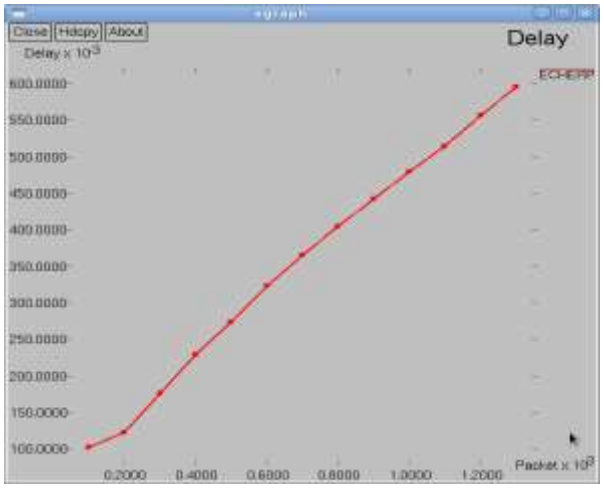

Figure 4 Delay

Figure 4 shows the delay of ECHERP protocol for 100 for one communication round.

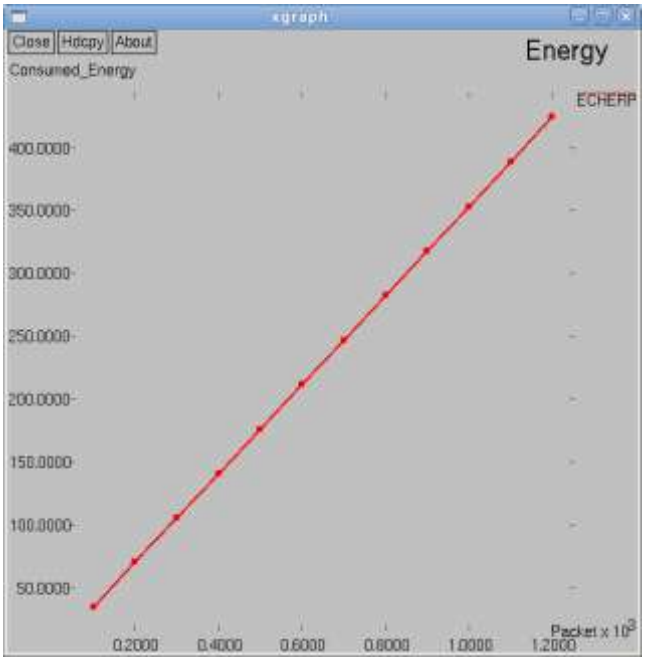

Figure 5 Energy Consumption

Figure 5 indicates energy consumed by 100 nodes under ECHERP protocol.

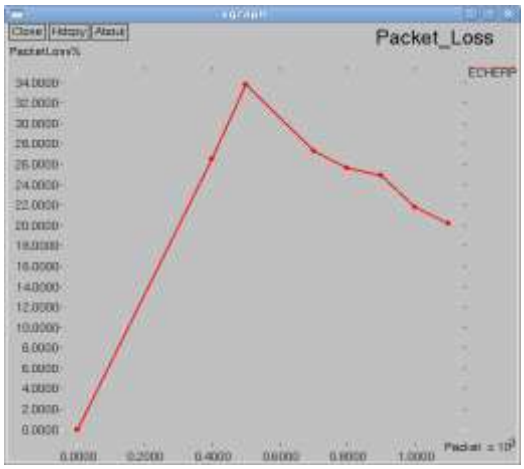

Figure 6 Packet drop ratio

Figure 6 shows the packet loss ratio for 100 nodes, it represent number of packet lost in network with respect to number of packet send.

Figure 7 shows throughput of ECHERP protocol for 100 nodes scenario.

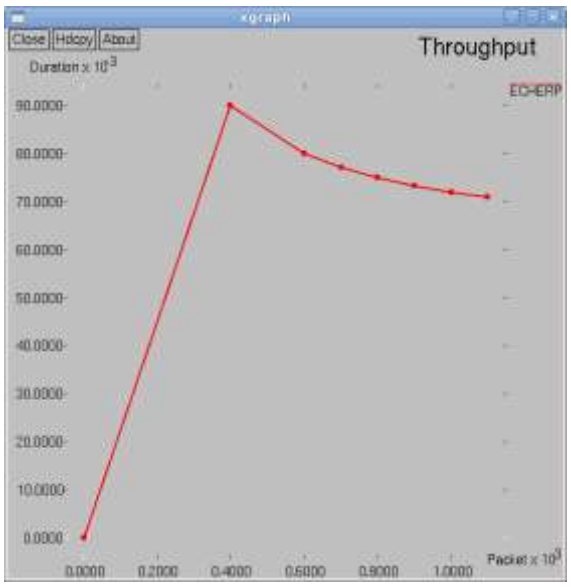

Figure 7 Throughput

V. CONCLUSION

In this paper, we proposed a Cluster Based Hierarchical routing protocol ECHERP which is used to equalized CH selection procedure in order to increase the network lifetime. The proposed protocol uses a Gaussian Elimination Algorithm to find the CHs and the number of round they can be CH to increase the network lifetime. CH selection procedure will be performed by BS. Based on selected CH, BS announces their ID number then nodes will use this information to form a Cluster. Communication in this protocol will happen between Cluster member and CH whereas CH will transmit the data to higher level CHs which in turn reaches to BS. The Simulation was performed on NS-2 Simulator. Based on extensive simulation, various QoS parameters have been derived to analyse the performance using 100 nodes. Simulation result shows that as the number of packets increases efficiency of protocol changes for different parameters.

REFERENCES

[1] W. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energy-Efficient Communication Protocol for Wireless Microsensor Networks," *Proceedings of the 33rd Annual Hawaii International Conference on System Sciences*, 2000.

[2] S. Vhatkar and M. Atique, "Design Issues and Challenges in Hierarchical Routing Protocols for Wireless Sensor Networks," *International Conference on Computational Science and Computational Intelligence*, vol. 1, pp. 90–95, 2014.

[3] A. Munir, "Cluster Based Routing Protocols: A Comparative Study," *IEEE Fifth International Conference on Advanced Computing & Communication Technologies*, pp. 590–594, 2015.

[4] X. Liu, "Atypical Hierarchical Routing Protocols for Wireless Sensor Networks: A Review," *IEEE Sensors J. IEEE Sensors Journal*, pp. 5372–5383.

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

[6] S. Nikolidakis, D. Kandris, D. Vergados, and C. Douligeris, "Energy Efficient Routing in Wireless Sensor Networks Through Balanced Clustering," *Algorithms*, pp. 29–42, 2013.

[7] H. S. K., "Energy Efficient Routing Protocol for Wireless Sensor Networks," *International Journal of Advanced Computer Research*, vol. 3, no. 10, pp. 95–100, Jun. 2013.
[8] H. D., C. Y., and Y. S., "A Novel Algorithm for Optimized Cluster Head Selection," *Science Journal of Electrical & Electronic Engineering*, 2013.
[9] Riham S. Elhabyan, C Mustapha C.E. Yagoub, "PSO-HC: Particle Swarm Optimization Protocol for Hierarchical Clustering in Wireless Sensor Networks," *10th IEEE International Conference on Collaborative Computing: Networking, Applications and Worksharing*, 2014.
[10] I. Sharma, R. Singh, and M. Khurana, "Comparative study of LEACH, LEACH-C and PEGASIS routing protocols for wireless sensor network," *IEEE International Conference on Advances in Computer Engineering and Applications*, pp. 254–262, 2015.
[11] R. K. Kodali and N. K. Aravapalli, "Multi-level LEACH protocol model using NS-3," *IEEE International Advance Computing Conference (IACC)*, pp. 375–380, 2014.
[12] M. Sharma and K. Sharma, "An Energy Efficient Extended LEACH (EEE LEACH)," *IEEE International Conference on Communication Systems and Network Technologies*, pp. 377–382, Rajkot, May 2012.
[13] W. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "An application-specific protocol architecture for wireless Microsensor networks," *IEEE Transactions on Wireless Communications*, vol. 1, no. 4, pp. 660–670, 2002.

SANGEETA VHATKAR
Research Scholar Department of Computer Science & Engineering
P.I.E.T Nagpur, AP-TCET,Mumbai

SAMREEN SHAIKH
M.E.I.T*(pursuing)*.,
Thakur College of Engineering and Technology, University of Mumbai, India.

MOHAMMAD ATIQUE
P. G. Department of Computer Science
Sant Gandge Baba Amravati University
Amravati, Maharashtra, India