# Energy Efficiency Routing in Wireless Sensor Networks using Child Sink Nodes

**Simple Preet Kaur Maan[1] Dinesh Kumar[2]**
[1]P.G. Student [2]Assistant Professor
[1,2]Department of Computer Science and Engineering
[1,2]GZS PTU Campus, Bathinda Punjab Technical University, Jalandhar

*Abstract*— Wireless sensor network (WSN) consists of hundreds of sensor nodes organized in a particular order and deployed in geographical area to achieve presumed goal. Though WSNs have restrictions in terms of memory and processors, the main restraint that makes WSNs dissimilar from conventional networks is the battery trouble which limits the network lifetime. Transmission of data requires more energy as compared to sensing data. Distance between source and destination plays an important role in energy utilization. Sensor networks using the concept of mobile sinks is an optimum approach for maximizing the lifetime of WSN. Sink node aggregates the data from the common sensor nodes to conserve the battery of the different nodes. The data collected by sink node is then forwarded to the base station node.

***Key words:*** Wireless Sensor Network, Energy Consumption, Cluster Head, Sink Node

## I. Introduction

In recent years, progress in wireless communications and electronics have led to the expansion of low-cost and small size sensor nodes, which can be embedded or deployed in various environments in order to carry out a specific task through a wireless sensor network (WSN). As a result, WSN has become a critical research area because of its large potentials of applications in varied fields such as civilian, industrial, imaging, medical, home automation, traffic control and military applications.

A large number of small, low cost, battery operated and multifunctional sensor nodes are either deployed randomly or placed carefully over a geographical area and grouped through wireless links to form a WSN.WSN monitors and records the conditions of different locations. Each sensor node works on battery. In most of the applications, these sensor nodes suffer from limited energy supply and communication bandwidth. Prolonging the lifetime of these sensor nodes is a major issue these days. In WSN the sink nodes collect the data from the different sensor nodes and forward the data to the base station node. In this paper we have analyzed different approaches in WSNs which focus on extending the lifetime of the network.

## II. Related works

In [1], authors comes up with an idea of developing an proficient routing protocol for particular mobile sink and multiple mobile sinks for gathering of the data in WSNs. In this scheme, the next position of the sink is determined by using biased random walk method. After this the optimal data transmission path is found using rendezvous point selection with splitting tree technique. If the sink moves within the range of the rendezvous point, it receives the gathered data and if it moves out of the range, it chooses a relay node from its neighbours to pass the packets from meeting point to the sink. The scheme suggested here is effective in reducing the signal overhead and improving the triangular routing problem. The sink behaves like a vehicle and collects the data from the sensor. The proposed model successfully supports sink mobility with lesser overhead and delay as compared to Intelligent Agent-based Routing protocol (IAR) and also extends the consistency and delivery ratio when the number of sources increases.

In [2], author uses optimum approach i.e. Leach-C to increase the lifetime of a wireless sensor networks. In this approach, cluster heads are distributed all over the network for better performance. Sink collects the data from each cluster heads by finding the optimum path with the help of travelling salesman problem. Here energy consumption is reduced by using Leach-C and travelling sales problem. Mobile sink gathers data, hence, reducing the energy consumption and so extends the network lifetime.

In [3], authors focus on using a mobile sink node which is considered as an important technique to improve network performance by collecting the data from each sensor node and then communicate through the network. There are certain techniques to consume the communication energy of sensor node. The distance among the source and recipient is predicted before available communication and then lowest transmission power needed to transmit the measurement data is then calculated and determined. The sensor nodes are also set to sleep/wake-up mode for energy saving in normal operating condition.

In [4], the authors have proposed the concept of Clustering and multi-hop routing algorithms which are the most widely used in hierarchical routing protocol for Wireless Sensor Networks (WSN). In presented clustering and multi-hop routing algorithms, cluster head (CH) is erratically elected and the nodes near to the Base Station (BS) known as `hotspot nodes' are responsible for forwarding the data, both of which lead to unbalance energy consumption in complete network. This paper proposes an Energy-efficient routing Protocol Based on `Hotspot-aware' uneven clustering and Dynamic Path Selection (PHADPS). In `hotspot', this protocol increases the number of CHs for forwarding the data so it can stable the energy utilization between CHs in `hotspot' and other areas. After completion of the clustering, each CH establishes a path table and dynamically prefers the next hop node from the path table when sending every single frame of data. This protocol is able to cope with the distorted `hotspot' issue and can prolong the network lifetime.

In [5], authors propose a new strategy in which nodes send their data to the sink via multi-hop path of reduced length and all nodes maintain a buffer in which they store their data before sink comes closer to them. This exempts the different sensors to relay the data. This strategy is effective in saving the energy along with a check that no data has been lost due to buffer overflow. WSN lifetime is optimized through controlled sink mobility and limited buffer capacity using Linear Program (LP). LP determines the time a sink stays at a particular location, data transfer rate between the nodes and the quantity of buffered packets. The proposed solution claims to achieve better lifetime, generate and transmit more data to the mobile sink and more load balancing among the nodes. A distributed algorithm is derived from the numerical results of data collection in WSN.

In [6], authors propose a novel network construction and routing method by defining three different duties for sensor nodes i.e. node gateways, cluster heads and cluster members and then by applying a hierarchical structure from sink to the normal sensor nodes. The proposed method provides an efficient rationale to support the maximum coverage to recover the missing data with node mobility and to reduce the energy wastage. In this way the lifetime of the network improves significantly.

In [7], the paper investigates the advantages of using controlled sink mobility in clustered wireless sensor networks (WSNs) which increases network lifetime. In a clustered sensor network, all Cluster Heads (CHs) have to transmit their buffered data to the sink during a specified interval, called data reporting time (tdr). This paper proposes a scheme that prescribes the sink path for collecting all CHs data in tdr time span while maximizing network life time using the mathematical model MILP (Mixed Integer Linear Programming). The proposed scheme is compared with other related schemes by means of various simulation scenarios. Simulation results show that the proposed scheme significantly outperforms other schemes.

In [8], the authors proposed a concept that balances consistency and remaining energy to manage the success rate of message broadcast. By devising the weights of the consistency and remaining energy, the metric called reliability-energy metric is designed to measure routing path and an efficient algorithm is developed based on Dijkstra algorithm to search a reliability-energy disjoint path set.

In [9], authors analyze LEACH (Low Energy Adaptive Clustering Hierarchy) which is the basic distributed clustering routing protocol and propose a new routing protocol and data aggregation scheme where all sensor nodes form the clusters and on the basis of the residual energy of each individual node, cluster heads are elected so that re-clustering is not required. Node Scheduling scheme (ACTIVE and SLEEP mode) is adopted in each cluster of the WSNs, thus rising the energy efficiency upto 50% as per compared to the LEACH protocol. This extends the network lifetime considerably.

In [10], authors consider a target-tracking sensor network and improve its energy awareness through predicting a target trajectory and decreasing sampling rate of sensors while maintaining an acceptable tracking accurateness. The tracking problem is devised as a hierarchical Markov decision process (MDP) and is solved through neuro-dynamic programming. Improvements in performance of the network are achieved by use of a reinforcement learning algorithm to solve the MDP that converges faster than the preceding used methods, since the energy efficiency and speed of convergence of the solution are tightly coupled.

In [11], authors suggest a new clustering scheme EECS for WSNs which is better applicable in the periodical data congregation applications. In this approach cluster heads with more residual energy are elected through local radio communication while realizing fine cluster head allocation. It also introduces a novel method to balance the load among the cluster heads. Result of simulation shows that EECS outperforms LEACH significantly with prolonging the lifetime of network more by 35%.

In [12], author proposes a new regional energy aware clustering scheme by means of isolated nodes for WSNs known as Regional Energy Aware Clustering with Isolated Nodes (REAC-IN). CHs are selected based upon weight in REAC-IN. Weight is found according to the remaining energy of each sensor node and the regional average energy of all sensors in each cluster. Inappropriately designed distributed clustering algorithms can cut off the nodes from CHs. These cut off nodes communicate with the sink by consuming excess amount of energy. To extend the lifetime of the network, the local average energy and distance between the sensors and the sink are used to determine whether the isolated node sends its data to a CH node in the previous round or to the sink.

In [13], authors come up with an energy-efficient routing scheme called Enhanced Energy-Efficient Protocol with Static Clustering (E3PSC) which is actually a modification of an existing routing scheme called as Energy-Efficient Protocol with Static Clustering (EEPSC). The present work partitions the network into distance-based static clusters as happens in EEPSC. But unlike EEPSC, cluster-head selection is performed by taking into account both the spatial distribution of sensors nodes in network and their residual energy with an aim to decrease the intra-cluster communication overhead among the nodes making the proposed scheme more energy-efficient. Qualitative and quantitative analysis is performed to prove energy efficiency of the proposed scheme and a number of experiments are being carried out to evaluate the performance of the scheme and to compare its results with EEPSC.

In [14], authors suggest a scheme for WSNs known as self-adaptive clustering based scheme. They confer the dynamic clustering scheme for the self-configuration of nodes in the WSN. A self-adapting algorithm for optimizing the sleep times of the nodes in the cluster by adapting to varying traffic loads is also briefly discussed in this paper. The main aim is to produce a consistent and strong sensing network that assures more energy saving, scalability, and extended lifetime for the WSN. The proposed scheme is applicable to all standard applications where WSNs can be used.

## ACKNOWLEDGMENTS

The paper has been written with the kind assistance, guidance and active support of my department who have helped me in this work. I would like to thank all the individuals whose encouragement and support has made the completion of this work possible.

## REFERENCES

[1] Madhumathy, P.; Sivakumar, D., "Enabling energy efficient sensory data collection using multiple mobile

sink," Communications, China, vol.11, no.10, pp.29, 37, Oct. 2014

[2] P. Dekate, 'An Efficient Algorithm for Sink Mobility to Extend Lifetime of Homogeneous Wireless Sensor Networks',International Journal of Current Engineering and Technology, vol. 4, 3, no. -2277-4106, -2347-5161, 2014

[3] Palaskar, S.P.; Chavhan, N.A., "Design and Implementation of Energy Efficient Node Data Transmission by Using Mobile Sink Node," Communication Systems and Network Technologies (CSNT), 2014 Fourth International Conference on , vol., no., pp.79,82, 7-9 April 2014

[4] Kang Zhu; Qiang Dou; Aihua Shao; Peisi Chu; Yonghua Xiao; Yunfeng Peng, "An Energy-efficient routing Protocol Based on Hotspot-aware uneven clustering and Dynamic Path Selection," Wireless and Optical Communication Conference (WOCC), 2013 22nd , vol., no., pp.315,320, 16-18 May 2013.

[5] Rault, T.; Bouabdallah, A.; Challal, Y., "WSN lifetime optimization through controlled sink mobility and packet buffering," Global Information Infrastructure Symposium, 2013, vol., no., pp.1, 6, 28-31 Oct. 2013

[6] A Hosen, S. Kim and G. Cho,, L "'An Energy efficient Cluster Formation and Maintenance Scheme for Wireless Sensor Networks', Journal of Information and Communication Convergence Engineering, 2012.

[7] Tashtarian, F.; Moghaddam, M.H.Y.; Effati, S., "Energy efficient data gathering algorithm in hierarchical wireless sensor networks with mobile sink," Computer and Knowledge Engineering (ICCKE), 2012 2nd International eConference on , vol., no., pp.232,237, 18-19 Oct. 2012.

[8] Huajun Meng; Fang-Ming Shao; Wei An, "The routing algorithm based on reliable path and efficient energy in wireless sensor network," Information Science and Engineering (ICISE), 2010 2nd International Conference on, vol., no., pp.2467, 2470, 4-6 Dec. 2010.

[9] Saravana Kumar, R.; Susila, S.G.; Raja, J., "An energy efficient cluster based node scheduling protocol for Wireless sensor networks," Solid-State and Integrated Circuit Technology (ICSICT), 2010 10th IEEE International Conference on, vol., no., pp.2053, 2057, 1-4 Nov. 2010.

[10] Yasami, K.; Ziyadi, M.; Abolhassani, B., "An Improved Hierarchical Markovian Target Tracking (I-HMTT) Algorithm for Energy Efficient Wireless Sensor Networks". Communication Networks and Services Research Conference, 2009. CNSR '09. Seventh Annual, vol., no., pp.325, 329, 11-13 May 2009

[11] Mao Ye; Chengfa Li; Guihai Chen; Jie Wu, "EECS: an energy efficient clustering scheme in wireless sensor networks," Performance, Computing, and Communications Conference, 2005. IPCCC 2005. 24th IEEE International, vol., no., pp.535, 540, 7-9 April 2005.

[12] Jenq-Shiou Leu; Tung-Hung Chiang; Min-Chieh Yu; Kuan-Wu Su, "Energy Efficient Clustering Scheme for Prolonging the Lifetime of Wireless Sensor Network With Isolated Nodes," Communications Letters, IEEE , vol.19, no.2,pp.259,262,Feb.2015.

[13] Chaurasiya, S.K.; Pal, T.; Bit, S.D., "An Enhanced Energy-Efficient Protocol with Static Clustering for WSN," International Conference on Information Networking (ICOIN), 2011, vol., no., pp.58, 63, 26-28 Jan. 2011.

[14] Raghuwanshi, S.; Mishra, A., "A self- adaptive clustering based algorithm for increased energy-efficiency and scalability in wireless sensor networks," IEEE 58th Vehicular Technology Conference, 2003., vol.5, no., pp.2921, 2925 Vol.5, 6-9 Oct. 2003.

 