# EFFICIENT DATA GATHERING TECHNIQUES IN WIRELESS SENSOR NETWORK

**C.Nandagopal**
*Assistant professor, M. Kumarasamy College of Engineering, Karur, Tamil Nadu*

**S.M.Ramesh**
*Dean, E.G.S.Pillay College of Engineering, Nagapattinam, Tamil Nadu*

**Abstract**

*Data collection from sensor nodes to sink is challenging issue in WSN applications like life monitoring, security surveillance. In WSN architecture, the sink is static and all the nodes in the network forward their data to the sink via multi-hop communication. As a result, nodes near to the sink loss their power; namely hot spot problem. Hotspot problem is the phenomenon when the nodes near to the sink quickly loss their energy due to relaying the data of the nodes farther from the sink. Hence, despite the nodes farther from the sink has significant energy left, their energy cannot be utilized as the nodes near to the sink have losed their energy and hence, it could not transfer their data to the sink across hot spot or energy hole near the sink. It can minimize network lifetime.*

***Keywords:*** *Gathering, WSN, Survey*

## Introduction

Wireless sensor networks has tiny miniaturized low-cost devices having limited sensing, processing and computational capabilities, densely deployed across the monitored area. They have a wide range of applications in various fields like environmental monitoring, surveillance, law enforcement, etc. In the typical applications, the sensors monitor their neighboring area, extract information and transfer sensed data to remote sinks that reconstruct the overall characteristics of the phenomenon [1] [6][10].

Due to the large number of nodes, their low cost, or the amount of time they are expected to be deployed in a potentially inaccessible area, energy efficiency becomes perhaps the most important design parameter for sensor networking protocols [2][11]. The sensor nodes forming WSN have resource constraints such as limited power, slow processor, and less memory. In addition, WSN has limited available bandwidth [4].

Data aggregation techniques require varying amounts of energy to process raw data. The choice of data aggregation method depends on the application requirements as well as the relative energy savings obtained by using this method. As various sensor nodes often detect common phenomena, there will be some redundancy in the data. Meanwhile, many applications deploy more sensors than the exact requirement so as to accurately sense the target phenomena. Eliminating the redundancy as well as energy consumption is always an issue [5][8].

Typically, the energy of a sensor is consumed on two major works: sensing the field and uploading data to the sink. Energy consumption on sensing is relatively constant as it depends only on the sampling rate. Meanwhile, the energy consumption on data uploading is non-uniform among sensors [3].

In WSN, sensors near the sink while sending the data of the nodes away from the sink drain their energy very quickly. It leads to network partitioning and can significantly limit the network lifetime. This problem is named as hotspot problem. Now, the formation of hot spot or energy hole near the sink has emerged as a critical issue for data gathering in WSN.

Data collection from source sensor nodes to sink is a common and challenging issue in WSN applications like animal monitoring, security surveillance. In a typical WSN architecture, the sink is static and all the nodes in the network forward their data to the sink via multi-hop communication. As a result, nodes near to the sink less their battery power; namely hot spot problem. Hotspot problem is the issue when the nodes near to the sink quickly drain their energy due to relaying the data of the nodes farther from the sink. Despite the nodes farther from the sink has significant energy left, their energy cannot be utilized as the nodes near to the sink have depleted their energy and hence, it could not send their data to the sink across hot spot or energy hole near the sink. It can significantly minimize network lifetime. [16].

The energy hole problem can be overcome by enabling mobile sinks to move out from energy depleted areas. By traveling around the network, mobile sinks can gather sensed data with even power consumption among sensor nodes [17].

**Data Gathering Techniques**

Xi Xu et al [12] proposed optimize a data aggregation architecture model combinig a multi-resolution hierarchical structure with CS to further the amount of data transmitted. The multiple compression thresholds were adaptively set up based on the cluster sizes at different levels. The advantages of the proposed aggregation model in contrast to other state-of-the-art related work were measured in terms of total amount of data for transmission, data compression ratio and energy consumption.

Miao Zhao et al [13] presented a joint design of controlled mobility and SDMA technique for data gathering with a single SenCar and multiple SenCars and formalized them as MDG-SDMA and MDG-MS problems. Then MDG-SDMA problem was formulated into an integer linear program (ILP) and prove its NP-hardness. Then three algorithms were proposed to solve this problem. In addition, a region division and tour-planning (RDTP) algorithm was proposed for the MDG-MS problem.

Miao Zhao and Yuanyuan Yang [14] proposed to use mobility for joint energization and data gathering. A multi-functional mobile entity, called SenCar was employed, not only as a mobile data collector roaming over the field to collect data via short-range communication but also as an energy transporter that charges static sensors on its migration tour via wireless energy transmissions. Taking advantages of SenCar's controlled mobility, the joint optimization of effective energy charging and high-performance data collections were performed. The positions of a subset of sensors were periodically selected as anchor points, where the SenCar will be sequentially visited to charge the sensors at these locations and gathered data from nearby sensors in a multi-hop fashion. A selection algorithm was given to search for a maximum number of anchor points where sensors hold the least battery energy, and by visiting them, the tour length of the SenCar was no more than a threshold to achieve a desirable balance between energy replenishment amount and data gathering latency. Then data gathering performance was performed when the SenCar moves among these anchor points. The problem was formulated as a network utility maximization problem and proposed a distributed algorithm to adjust data rates at which sensors send buffered data to the SenCar, link scheduling and flow routing so as to adapt to the up-to-date energy replenishing status of sensors.

Dawei Gong and Yuanyuan Yang [15] proposed a data gathering tree based on a reliability model, scheduled data transmissions for the links on the tree and assigned transmitting power to each link accordingly. The joint problem of tree construction, link scheduling and power assignment was formulated for data gathering

Liu Xiang et al. [19] have proposed a compressed data aggregation scheme that ues compressed sensing (CS) technique to achieve energy efficiency and recovery fidelity in WSNs with arbitrary topology. Diffusion wavelets are used to find the sparse basis for characterizing the spatial correlations well on arbitrary WSNs. This can provide straightforward CS-based data aggregation along with data recovery at the sink with high fidelity. Moreover, minimum-energy compressed data aggregation problem is discussed to prove its NP-completeness. A mixed integer programming formulation is proposed along with a greedy heuristic to solve it. Simulations are conducted with both real datasets and synthetic datasets.

**Problem Identification**

In [4], all sensor nodes used in gathering all the sensed data and transferring them to the sink node. As all the nodes in the network are charged for the heavy workload, the sensor nodes consume their energy almost equally and the hotspot problem can be significantly relieved. In [16], mobile sink also maintains information about the residual energy of the CHs while data gathering. Mobile sink based on the residual energy of CHs move to the CHs having higher energy. As a result, the hotspot problem is reduced as the immediate neighbor of the sink is high energy node and it changes because of regular sink movement. It ended in a balanced use of WSN energy and improved network life time. [17] Considered data acquisition with guaranteeing latency in WSN by multiple mobile sinks. The number of sinks, as well as the continuous of each sink, was optimized for this problem to minimize total cost. [18] update a distributed sink location and a tree-based data gathering mechanism for mobile sink WSNs deployed a Multi-Point Relay (MPR) forwarding for sink location updates and queries. The sensor nodes dynamically update MPR broadcast based sink location updates whereby sensor nodes forward new sink update messages only if sink mobility has affected their path towards the sink. Hence the objective of the proposed research works involves the following phases:

1. To perform extensive literature survey of existing data gathering techniques in WSN.
2. To compare the performance of existing data gathering techniques in WSN

3. To develop data gathering technique for energy hole problem in WSN to provide
   - reduced latency
   - high efficiency
   - low energy consumption
   - high data rate
4. Implement the proposed data gathering technique in NS-2 and show the performance improvement with existing data gathering techniques

**Result and discussion**

Hence we propose to find a scheme for data gathering technique with energy efficiency in WSN. To enchance the efficiency, we place multiple sensors arranged to form clusters for intermediate data collection instead of a single sink node targeted by all the sensors nodes. Then multi compression levels were set up based on the cluster sizes at different values. Here leaf nodes transit their sensed data to their cluster heads. The CH observes compressed sensing measurements and do CS recovery algorithm. In addition, we will use optimal minimum covering spanning tree algorithm each mobile data collector with multiple antennas and apply SDMA (Space Division Multiple Access) techniques to data gathering. The proposed data gathering technique can be simulated in Network Simulator. The performance is evaluated according to the metrics Average Energy consumption, efficiency, packet drop, end-to-end delay and overhead.

**References**

5. M. Borghini, F. Cuomo, T. Melodia, U. Monaco and F. Ricciato, "Optimal Data Delivery in Wireless Sensor Networks in the Energy and Latency Domains", Proceedings of the First International Conference on Wireless Internet (WICON), 2005.
6. Prithwish Basu and Jason Redi, "Effect of Overhearing Transmissions on Energy Efficiency in Dense Sensor Networks", Third International Symposium on Information Processing in Sensor Networks, IPSN 2004.
7. Miao Zhao, Ming Ma and Yuanyuan Yang, "Mobile Data Gathering with Space-Division Multiple Access in Wireless Sensor Networks", in the IEEE INFOCOM proceedings, 2008.
8. Rabindra Bista, Yong-Ki Kim, and Jae-Woo Chang, "A New Approach for Energy-Balanced Data Aggregation in Wireless Sensor Networks", IEEE Ninth International Conference on Computer and Information Technology, 2009.
9. Peiman Ghaffariyan, "An Effective Data Aggregation Mechanism for Wireless Sensor Networks", 6th International Conference on Wireless Communications Networking and Mobile Computing (WiCOM), 2010.
10. Miao Zhao and Yuanyuan Yang, "Data Gathering in Wireless Sensor Networks with Multiple Mobile Collectors and SDMA Technique Sensor Networks", in the WCNC proceedings, 2010.

11. Chi Yang, Zhimin Yang, Kaijun Ren and Chang Liu, "Transmission Reduction based on Order Compression of Compound Aggregate Data over Wireless Sensor Networks", 6th International Conference on Pervasive Computing and Applications (ICPCA), 2011.
12. Songtao Guo and Yuanyuan Yang, "A Distributed Optimal Framework for Mobile Data Gathering with Concurrent Data Uploading in Wireless Sensor Networks", Proceedings IEEE INFOCOM, 2012.
13. Basavaraj S. Mathapati, Siddarama. R. Patil and V. D. Mytri, "Energy Efficient Reliable Data Aggregation Technique for Wireless Sensor Networks", International Conference on Computing Sciences, 2012.
14. Ning Jin, Kaiji Chen and Tao Gu, "Energy Balanced Data Collection in Wireless Sensor Networks", 20th IEEE International Conference on Network Protocols (ICNP), 2012.
15. Songtao Guo, Cong Wang and Yuanyuan Yang, "Mobile Data Gathering with Wireless Energy Replenishment in Rechargeable Sensor Networks", Proceedings IEEE INFOCOM, 2013.
16. Xi Xu, Rashid Ansari and Ashfaq Khokhar, "Power-efficient Hierarchical Data Aggregation using Compressive Sensing in WSNs", IEEE ICC - Ad-hoc and Sensor Networking Symposium, 2013.
17. Miao Zhao, Ming Ma, and Yuanyuan Yang, "Efficient Data Gathering with Mobile Collectors and Space-Division Multiple Access Technique in Wireless Sensor Networks", IEEE Transactions On Computers, Vol. 60, No. 3, March 2011.
18. Miao Zhao, Ji Li, and Yuanyuan Yang, "A Framework of Joint Mobile Energy Replenishment and Data Gathering in Wireless Rechargeable Sensor Networks", IEEE Transactions On Mobile Computing, Vol. 13, No. 12, December 2014.
19. Dawei Gong and Yuanyuan Yang, "Low-Latency SINR-Based Data Gathering in Wireless Sensor Networks", IEEE Transactions On Wireless Communications, Vol. 13, No. 6, June 2014.
20. Babar Nazir and Halabi Hasbullah, "Mobile Sink based Routing Protocol (MSRP) for Prolonging Network Lifetime in Clustered Wireless Sensor Network", International Conference on Computer Applications and Industrial Electronics (ICCAIE), Kuala Lumpur, Malaysia, December 5-7, 2010.
21. Huan Ke, Song Guo and Toshiaki Miyazaki, "Towards Latency-Aware Data Acquisition in Wireless Sensor Networks", IEEE 8th International Symposium on Embedded Multicore/Manycore SoCs, 2014.
22. Yasir Faheem and Saadi Boudjit, "SN-MPR: A Multi-Point Relay Based Routing Protocol for Wireless Sensor Networks", IEEE/ACM International Conference on Green Computing and Communications & IEEE/ACM International Conference on Cyber, Physical and Social Computing, 2010.
23. Liu Xiang, Jun Luo, and Catherine Rosenberg, "Compressed Data Aggregation: Energy-Efficient and High-Fidelity Data Collection", IEEE/ACM transactions on networking, vol. 21, no. 6, 2013.

24. Fei Yuan, Yiju Zhan, and Yonghua Wang, "Data Density Correlation Degree Clustering Method for Data Aggregation in WSN", IEEE Sensors Journal, Vol. 14, No. 4, 2014.
25. Mohammadreza Soltani, Michael Hempel, and Hamid Sharif, "Data Fusion Utilization for optimizing Large-Scale Wireless Sensor Networks", IEEE ICC 2014 - Ad-hoc and Sensor Networking Symposium, 2014.
26. Shiliang Xiao, Baoqing Li, Xiaobing Yuan, "Maximizing precision for energy-efficient data aggregation in wireless sensor networks with lossy links", Ad Hoc Networks 26 (2015) 103–113.
27. Luca Mottola, Gian Pietro Picco, "MUSTER: Adaptive Energy-Aware Multisink Routing in Wireless Sensor Networks", IEEE TRANSACTIONS ON MOBILE COMPUTING, VOL. 10, NO. 12, DECEMBER 2011.
28. Saeid Mottaghia and Mohammad Reza Zahabi, "Optimizing LEACH clustering algorithm with mobile sink andrendezvous nodes", Int. J. Electron. Commun. (AEÜ) 69 (2015) 507–514.