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CLUSTER BASED ENERGY EFFICIENT SCHEDULING ALGORITHM FOR WIRELESS SENSOR NETWORK

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***Abstract*— The high efficiency of Wireless Sensor Networks (WSNs) purely depends on the data collection scheme. Several data gathering schemes such as multipath, tree, chain, cluster and hybrid topologies are available in literature for gathering data in WSNs. However, the existing data gathering schemes failed to provide a guaranteed reliable network in terms of traffic, mobility, and end-to-end connection. Recent work shows sink mobility can increase the energy efficiency in WSNs. However, data delivery latency often increases owing to the speed limit of Mobile Sink. Most of them utilize the mobility, to address the problem of data gathering in WSNs. In this project, first define WSNs with Mobile Sink and provide an exhaustive taxonomy of their architectures, based on the role of MS. Then, present an overview of load balanced cluster and dual data uploading data gathering process in such a scenario, and recognize the corresponding challenges and issues. On the basis of these issues, Delay Aware Adaptive Multi Hop Routing Protocol called DAMHR is proposed, which is a heuristic method that locates a near-optimal traveling tour that minimizes the energy consumption of sensor nodes and improves the data gathering. Path selection problem is focused in load balanced clustering and delay-guaranteed sensor networks with a path-constrained mobile sink and concentrate on an efficient data gathering scheme, that simultaneously increases the total amount of data and reduces the energy consumption. The optimal path is preferred to meet the necessary on delay as well as minimizes the energy consumption of entire network. Predictable sink mobility is demoralized to improve energy efficiency of sensor networks.**

Index Terms*— Cluster Head, data collection, Mobility, Mobile Sink, Polling Point, Wireless Sensor Networks.

I. INTRODUCTION

Wireless Sensor Networks is a collection of spatially deployed wireless sensors to monitor several changes of environmental conditions such as air pollutant concentration, forest fire, and object moving for collaborative manner without relying on any primary infrastructure support. In recent times, a number of research efforts have been made to improve sensor hardware and network architectures in order to efficiently organize WSNs for a variety of applications.

Wireless Sensor Networks (WSNs) is the multi-hop communication wireless networks. Due to a wide diversity of WSN application requirements, although a general purpose WSN design cannot fulfill the requirements of all applications. According to some specific applications, several network parameters such as node density, sensing range, and transmission range have to be carefully considered at the network design phase. To achieve this, it is critical to capture the effects of network parameters on the network performance with respect to application requirements.

Wireless sensor networks are placed to monitor the sensing field and collect data from it. Usually, two approaches can be implemented to accomplish the data collection tasks: through direct communication, and multi-hop forwarding. In the first phase, sensor nodes upload the data directly to sink through one-hop wireless communication; this may result in long communication distances and destroy the energy efficiency of sensor nodes. On the other hand, by multi-hop forwarding, data are informed to the sink over multiple relays, and the communication distance is minimized. However, since nodes near the sink commonly have a much denser forwarding load, their energy may be exhausted very fast, which reduces the network performance. The goal of the sensor node is to gather the data at fixed intervals then transfer the data into digital signal and eventually send the signal to the sink or the base node. Before monitoring the location, the sensor nodes must forms a network and identify their neighbour nodes. Energy consumption can takes place while uploading the data and sensing the field to Mobile Collector.

II. LITERATURE REVIEW

In this chapter, a brief description of different papers about geographic routing, cluster formation, data collection, data forwarding, energy consumption and transmission of node to sink is carried out. In modern years, a number of studies have discussed the problems of data collection techniques to discover the efficient path.E. Lee, S. Park, F. Yu, and S.-H. Kim et al., specified the geographic routing protocols on sensor networks focuses on locating ways to guarantee data forwarding from the source to destination, and many protocols have not been done on gathering and aggregating data of sources in adjacent and a local region. However, data generated from the sources in the region are often highly correlated and redundant. Consequently, gathering and aggregating data from the region in the sensor networks is significant and necessary to save wireless resources and the energy of sensor nodes. To address this issue, the concept of a local sink and Single Local Sink Model in geographic routing is introduced**.** In Local sink, an entity that gathers locally data in a local and adjacent region, then delivers the aggregated data to a global sink. A Global Sink locates in a specific position of the network. It is a base station (or sink) which gathers data from the entire sensor fields and provides them to users in wireless sensor networks. Single local sink is accomplished of carrying out several sources in a large-scale local and adjacent region. This Model is used for defining the optimal location of single local sink because the deadline of data is constrained and the buffer size of a local sink is limited. Then, they also prolong the Single Local Sink Model to a Multiple

Local Sinks Model. Hence these are more effective in terms of the data delivery ratio, deadline miss ratio, and the energy consumption.

Miao Zhao and Yuanyuan Yang et al., proposed a three-layer framework (sensor layer, cluster head layer and mobile collector) called LBC-MU.It works distributed load balanced clustering and multiple-input and multiple-output (MIMO)uploading techniques a huge number of sensors and a limited number of mobile data collectors in a wireless sensor network. Mobile collectors can take over the burden of routing from sensors, peripatetic over the sensing area and gathering the data from nearby sensors through short-range wireless communications. This approach designed a series of efficient mobile data gathering schemes, which aims to shorten data gathering latency and prolong network lifetime. Moving trajectory planning with multi-hop relays. Moving trajectory planning algorithm is adopted by divide and conquer method that recursively determines a turning point on the path. In mobile collector, the moving path of is dynamically based on the load balancing among sensors, and distribution of sensors is performed along with the moving trajectory planning to prolong the lifetime of network. The objective of this paper is to achieve low data collection latency, long network lifetime and scalability.

X. Tang and J. Xu et al., focuses on the data collection schemes for lifetime constrained in wireless sensor network. The aim is to maximize the accuracy of data collection over the network lifetime by the base station. It is used to develop adaptive update strategy and optimal update strategy for both aggregate and individual data collection. Various sensor networks are deployed to operate for a selected time period is known as network lifetime. Offline algorithm, an algorithm to allocate the numbers of updates is established to compute the optimal data update strategy. Then formulate the lifetime constrained data collection problem in sensor networks show that, compared with the periodic strategy, adaptive strategies significantly increase the accuracy of data collected by the base station.

L. Song and D. Hatzinakos et al., scheduling issues in node to sink transmission. Specifically, the exchange between the probability of successful node energy consumption cost and data retrieval, is studied. The optimization in the framework of dynamic programming is formulated. They focused on sparsely deployed networks, wherever the basic model of single node to sink transmission is considered. This simplified model helps us to understand the fundamental rules and facilitates the analysis behind the above mentioned tradeoff. This model does have practical worth, though it may not always be true that one sensor is within the communication range to the sink, it can be assumed that only one sensor in the range has packets of attention to the sink or supposing there are multiple wireless channels available and only one node will transmit in a specific channel. Thus, the results in the paper serves as the basis for the study of more sophisticated multiple nodes to sink transmission scheduling issues that rise in densely deployed networks.

A.A. Somasundara, A. Ramamoorthy, and M.B. Srivastava et al., focuses on the usage of sensor networks to measure and sense the environment. This leads to a wide diversity of practical and theoretical issues on suitable protocols for transfer and data sensing. In most cases, the sensors are battery constrained that creates the problem of energy efficiency of utmost importance. Both these deployments focus on the problem of environment monitoring and habitat. One can also envision scenarios where a sensor network is utilized to sense pollution levels at planned locations in a large city. Certainly, there will be areas in which variance in pollution level will be more such as manufacturing areas as compared to residential areas. By capturing these behaviors, the sensing rates of sensors at various positions will typically need to be dissimilar. The sensor nodes in areas with greater variation in the phenomenon need to sample more often. Wireless networks have historically considered support for Mobile Elements (ME) as an extra overhead. However, recent study has provided by which network can take advantage of Mobile Elements (ME). In case of wireless sensor networks, particularly the mobile elements are deliberately constructed into the system to improve the network lifetime, and performance as mechanical carrier of data's. The Mobile Element (ME), which is controlled, visits the nodes to gather their data before their buffers are full. It may happen which the sensor nodes are sampling at different rates, in that case few nodes need to be visited more frequently than others. Then, present the problem of scheduling Mobile Element (ME), so that there is no data loss due to buffer overflow in the network.

III. EXISTING SYSTEM

In data collection sensor network applications, sensors are normally randomly scattered and densely deployed over a sensing field and left unattended after being organized, which makes it difficult to replace or recharge their batteries. Later sensors form into autonomous groups; those sensors near the data sink typically exhaust their batteries faster than others owing to more relaying traffic. While sensors around the data sink deplete their energy, coverage and network connectivity may not be guaranteed. Owing to these limitations, it is critical to design an energy-efficient data gathering scheme that consumes energy equally across the sensing field to attain long network lifetime. Additionally, sensing data in some requirements are time-sensitive, and data collection may be required to be performed within a specified time frame. Hence, an efficient, large-scale data collection scheme should aim at low data latency, long network lifetime and good scalability.

In this existing work, considered a three-layer mobile data collection framework and investigated the following layers:

1- Sensor layer

2- Cluster Head layer

3- SenCar layer

1-Sensor Layer

The sensor layer is the bottom and basic layer. Each sensor is assumed to be able to communicate only with its neighbors, i.e., the nodes within its transmission range. During initialization, sensors are self-organized into clusters. Each sensor decides to be either a cluster head or a cluster member in a distributed manner. In the end, sensors with higher residual energy would become cluster heads and each cluster has at most M cluster heads, where M is a system parameter. The benefit of such organization is that the intra-cluster aggregation is limited to a single hop. In the case that a sensor may be covered by multiple cluster heads in a CHG, it can be optionally affiliated with one cluster head for load balancing.

2-Cluster Head Layer

The cluster head layer consists of all the cluster heads. As a fore mentioned, inter-cluster forwarding is only used to send the CHG information of each cluster to SenCar, which contains an identification list of multiple cluster heads in a CHG. Such information must be sent before SenCar departs for its data collection tour. Upon receiving this information, SenCar utilizes it to determine where to stop within each cluster to collect data from its CHG. To guarantee the connectivity for inter-cluster communication, the cluster heads in a CHG can cooperatively send out duplicated information to achieve spatial diversity, which provides reliable transmissions and energy saving.

3-SenCar Layer

The top layer is the SenCar layer, which mainly manages mobility of SenCar. There are two issues to be addressed at this layer. First, we need to determine the positions where SenCar would stop to communicate with cluster heads when it arrives at a cluster. In LBC-DDU, SenCar communicates with cluster heads via single-hop transmissions. It is equipped with two antennas while each sensor has a single antenna and is kept as simple as possible. The traffic pattern of data uploading in a cluster is many-to-one, where data from multiple cluster heads converge to SenCar. Equipped with two receiving antennas, each time SenCar makes dual data uploading whenever possible, in which two cluster heads can upload data simultaneously.

To mitigate the impact from dynamic channel conditions, SenCar measures channel state information before each data collection tour to select candidate locations for data collection. We call these possible locations SenCar can stop to perform concurrent data collections polling points. In fact, SenCar does not have to visit all the polling points. Instead, it calculates some polling points which are accessible and we call them selected polling points. Since SenCar has pre-knowledge about the locations of polling points, it can find a good trajectory by seeking the shortest route that visits each selected polling point exactly once and then returns to the data sink.

The main aim of this is to exploit Multi-User Multiple-Input and Multiple-Output (MU-MIMO) method for simultaneous data uploading to shorten latency and to utilize scattered clustering for scalability, to employ mobility for uniform energy consumption and energy saving.

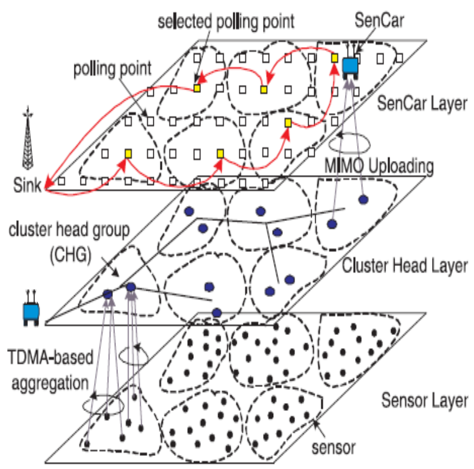


Fig 3.1.1

IV. PROPOSED SYSTEM

This proposed system examines an architecture based on mobility to discourse the problem of energy efficient data collection in a sensor network. The problem of data collection in sensor networks is encountered in many scenarios such as tracking animal relocation in remote-areas, monitoring physical environments, weather conditions in national parks, habitat monitoring on distant islands, traffic monitoring etc. The objective is to collect data from sensors and deliver it to an access location point in the infrastructure. Such systems are expected to run unattended for long periods of time (order of months). The principal restriction is the energy budget of the nodes which is limited due to their size and cost.

Recent research shows that major energy saving can be achieved in node mobility enabled wireless sensor networks that visit sensor nodes and gather data from them through short-range wireless communications. On the other hand, a major performance bottleneck of such WSN is the extensively increased end to end delay in data collection due to the low mobility of mobile base stations/sink. In large-scale Wireless Sensor Networks, leveraging sinks' mobility for data gathering has drawn significant interests in recent years. Present researches either focus on planning a mobile sink moving trajectory in advance to obtain optimized network QoS performance, or goal at collecting a small portion of sensed data in the network. Large classes of WSN applications involve a set of lonely urban areas (e.g urban parks or building blocks) covered by sensor nodes monitoring environmental factors. Mobile sink (MS) mounted upon urban vehicles with fixed trajectories (e.g buses or other vehicles) provide the ideal infrastructure to effectively recover sensory data from such isolated WSN fields. Previous approaches involve either one hop transfer of data from SN that lie within the MS range or weighty involvement of network border nodes in data retrieval, data processing, data buffering, and data delivering tasks. These nodes run the risk of quick energy exhaustion resulting in loss of QoS, network connectivity and decreased network lifetime.

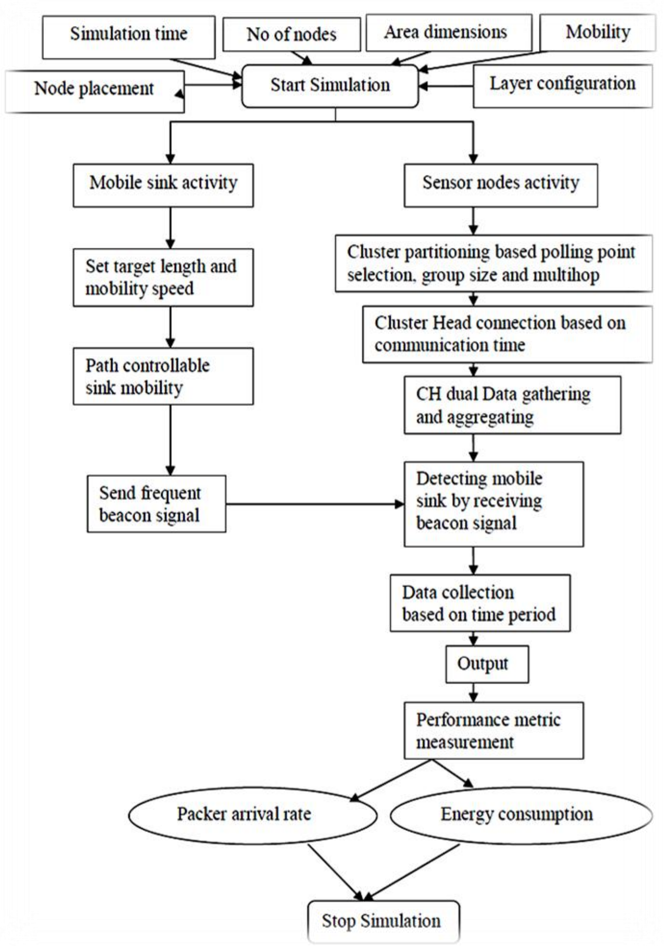
A. Delay Aware Adaptive Multi Hop Routing Protocol

Delay Aware Adaptive Multi Hop Routing Protocol (DAMHR) is proposed that simultaneously diminishes the energy consumption and increases the total amount of data.

Each member chooses the closest Polling Point (PP) in terms of hop distance as its destination and then sends its personal data or frontwards data from downstream nodes to upstream nodes along shortest path trees. Although, the number of members associated with each Polling point is independent of its communication time that may cause inequity in the assignment of members among the Polling point. It is possible that some Polling point own fewer members with longer communication time, indicating that the mobile sink may gather less data than the expected data. On the other hand, some Polling point with very short communication time may own too many members. Consequently, the excess data traffic may result in oversaturated Polling point's which are not able to transmit all data to the mobile sink in the limited communication duration. A communication protocol and a speed control algorithm of the mobile sink are suggested to improve the energy performance and the amount of data collected by the sink.

This proposed protocol called DAMHR aims at diminishing the overall network overhead and energy expenditure related with the data retrieval process whereas also ensuring prolonged network lifetime and balanced energy consumption among sensor nodes . This is achieved through constructing cluster structures contained of member nodes that route their measured data to their allotted cluster head (CH). Then, the CHs perform data sifting upon the raw data exploiting potential spatial-temporal data redundancy and forward the filtered information to their allotted Polling points, normally located in proximity to the Mobile Sink's (MS) path.

B. Architecture Diagram



A. System Models

1. Dual data clustering mechanisms
2. Polling Points (PP) Selection
3. Data aggregation and forwarding to the PP
4. Communication between PP and Mobile Sink
5. Performance measurements

1. Dual data clustering mechanisms

In cluster-based systems, Cluster Heads (CHs) will inevitably consume much more energy than other sensors due to handling inter-cluster data forwarding and intra-cluster aggregation. Each sensor is assumed to be able to communicate only with its neighbors, i.e., the nodes within its transmission range. During initialization, sensors are self-organized into clusters.

First, arranges the sensors into clusters, wherever each cluster has multiple cluster heads. This mechanism allows dual data uploading between the mobile collector and multiple cluster heads, and also balances the load of intra-cluster aggregation. Second, multiple cluster heads inside a cluster can collaborate with each other to perform the energy efficient inter-cluster transmissions.

For convenience, the multiple cluster heads within a cluster are called a cluster head group (CHG), with each cluster head being the peer of others. The benefit of such organization is that the intra-cluster aggregation is limited to a single hop. In the case that a sensor may be covered by multiple cluster heads in a CHG, it can be optionally affiliated with one cluster head for load balancing.

2. Polling Points (PP) Selection

In theory, since SenCar is mobile, it has the freedom to choose any preferred position. However, this is infeasible in practice, because it is very hard to estimate channel conditions for all possible positions. Thus, we only consider a finite set of locations called PP's (Polling Point). PP's guarantee connectivity of sensor islands with MS hence, their selection largely determines network lifetime. PP's lie within the range of traveling sinks and also their location depends on the position of the CH and sensor field with respect to the sinks path. Suitable PP's are those that remain within the MS range for comparatively extended time in relatively short distance from the sink's path and have sufficient energy supplies.

3. Data aggregation and forwarding to the PP

Efficient data gathering and aggregation algorithms for sensor networks (SNs) utilize the fact which a sensor node devours less energy for information (data) processing than for communication. Collecting information at the cluster head node level such as computing the sum or average of sensor readings reduces the essential for communication, instead of transferring the packets of each node individually. A node first aggregates the received packets of the nodes in communication range, then interconnects the aggregated information to the PP node in the collection path.

To avoid collisions during data aggregation, the CHG adopts time-division-multiple-access (TDMA) based technique to coordinate communications between sensor nodes. As aforementioned, the multiple cluster heads in a CHG coordinate among cluster members and collaborate to communicate with other CHGs. cluster heads in a CHG as multiple antennas both in the transmitting and receiving sides such that an equivalent MIMO system can be constructed. The self-driven cluster head in a CHG can either coordinate the local information sharing at the transmitting side or act as the destination for the cooperative reception at the receiving side. The inter-cluster transmissions are only used to forward the information of each CHG to PP's.

4. Communication between PP and Mobile Sink

The last phase of this proposed protocol involves the delivery of data buffered to PPs to MS (SenCar). Data delivery happens along an intermittently available link therefore, a key requirement is to determine while the connectivity between a PP and the MS (SenCar) is obtainable. To collect data as fast as possible, SenCar should stop at positions inside a cluster that can achieve maximum capacity. Communication should start when the connection is available and end when the connection no longer exists, so that the PP does not continue to transmit data when the MS is no longer receiving it.

In fact, SenCar does not have to visit all the polling points. Instead, it calculates some polling points which are accessible and we call them selected polling points. In addition, we need to determine the sequence for SenCar to visit these selected polling points such that data collection latency is minimized. Since SenCar has pre-knowledge about the locations of polling points, it can find a good trajectory by seeking the shortest route that visits each selected polling point exactly once and then returns to the data sink.

Performance Measurements

First, the necessary input parameters are needed to stipulate the Config.in file as said above. For simulation process, certain parameters are specified as mentioned below to enable hassle free simulation.

Terrain range – (500,500)

Number of nodes – 20 (This is a scalable simulator. Henceforth, the number of nodes can be increased at will.)

These parameters were followed to for the entire process of experimentation with the new protocol.

The performance of the proposed algorithm is calculated through GloMoSim simulator and the Performance metrics are used in the simulations for performance comparison:

i) **Packet arrival rate**-The ratio of the number of collected data packets to the number of total data packets sent by the source.

ii) **Average end-to-end delay**-The average time passed for delivering a data packet within a successful transmission.

iii) **Communication overhead**-The average number of transmitted control bytes per second with both the control packets and the data packet header.

iv) **Energy consumption**-The energy consumption for the entire network with transmission energy consumption for both the control and data packets.

V. CONCLUSION

In this paper, DAMHR protocol have presented for mobile data collection in a WSN. It aims at minimizing the overall energy consumption and network overhead while also ensuring the balanced energy consumption among sensor nodes and prolong network lifetime associated with the data retrieval process. This performance study demonstrates the effectiveness of the proposed protocol. The results shows that DAMHR protocol can knowingly reduce energy consumptions by improving routing problems on nodes and balancing workload among cluster heads, which achieves less data collection time compared to MU-MIMO mobile data gathering and energy saving on cluster heads. In this paper, the energy overhead also justified and explored the results with different numbers of cluster heads in the framework.

REFERENCES

[1] E. Lee, S. Park, F. Yu, and S.-H. Kim, “Data gathering mechanism with local sink in geographic routing for wireless sensor networks , IEEE Transactions on Consumer Electronics., vol. 56, no. 3, pp. 1433–1441, Aug. 2010.

[2] Miao Zhao, Member, IEEE, Yuanyuan Yang, Fellow, IEEE, “ A Framework for Mobile Data Gathering with Load Balanced Clustering and MIMO ”, IEEE INFOCOM , pp. 2759 – 2767,APRIL 2011.

[3] X. Tang and J. Xu, “Adaptive data collection strategies for lifetime-constrained wireless sensor networks,” IEEE Transactions on Parallel Distribution System., vol. 19, no. 6, pp. 721–7314, Jun. 2008.

[4] L. Song and D. Hatzinakos, "Architecture of Wireless Sensor Networks with Mobile Sinks: Sparsely Deployed Sensors,"*IEEE Transaction on Vehicular Technology,* vol. 56, no. 4, pp. 1826-1836, July 2007.

[5]A.A. Somasundara, A. Ramamoorthy, and M. B. Srivastava,“Mobile element scheduling for efficient data collection in wireless sensor networks with dynamic deadlines,” in Proceedings 25th IEEE International Real-Time System Symposium, pp. 296–305., Dec. 2004.

[6] B. Krishnamachari, Networking Wireless Sensors. Cambridge, U.K.: Cambridge Univ. Press, Dec. 2005.

[7] R. Shorey, A. Ananda, M. C. Chan, and W. T. Ooi, Mobile, Wireless, Sensor Networks. Piscataway, NJ, USA: IEEE Press, Mar. 2006.

[8] I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, “A survey on sensor networks,” IEEE Commun. Mag., vol. 40, no. 8, pp. 102–114, Aug. 2002.

[9] W. C. Cheng, C. Chou, L. Golubchik, S. Khuller, and Y. C. Wan, “A coordinated data collection approach: Design, evaluation, and comparison,” IEEE J. Sel. Areas Commun., vol. 22, no. 10, pp. 2004– 2018, Dec. 2004.

[10] K. Xu, H. Hassanein, G. Takahara, and Q. Wang, “Relay node deployment strategies in heterogeneous wireless sensor networks,” IEEE Trans. Mobile Comput., vol. 9, no. 2, pp. 145–159, Feb. 2010.

[11] O. Gnawali, R. Fonseca, K. Jamieson, D. Moss, and P. Levis, “Collection tree protocol,” in Proc. 7th ACM Conf. Embedded Netw. Sensor Syst., 2009, pp. 1–14.

[12] Y. Wu, Z. Mao, S. Fahmy, and N. Shroff, “Constructing maximum-lifetime data-gathering forests in sensor networks,” IEEE/ ACM Trans. Netw., vol. 18, no. 5, pp. 1571–1584, Oct. 2010.

[13] W. R. Heinzelman, A. Chandrakasan, and H. Balakrishnan, “An application-specific protocol architecture for wireless microsensor networks,” IEEE Trans. Wireless Commun., vol. 1, no. 4, pp. 660– 660, Oct. 2002.

[14] O. Younis and S. Fahmy, “Distributed clustering in ad-hoc sensor networks: A hybrid, energy-efficient approach,” in IEEE Conf. Comput. Commun., pp. 366–379, 2004.

[15] D. Gong, Y. Yang, and Z. Pan, “Energy-efficient clustering in lossy wireless sensor networks,” J. Parallel Distrib. Comput., vol. 73, no. 9, pp. 1323–1336, Sep. 2013.

[16] Miao Zhao, Member, IEEE, Yuanyuan Yang, Fellow, IEEE and Cong Wang, “Mobile Data Gathering with Load Balanced Clustering and Dual Data Uploading in Wireless Sensor Networks”, IEEE Transactions On Mobile Computing, Vol. 14, No. 4, April 2015.

[18] A. Amis, R. Prakash, D. Huynh, and T. Vuong, “Max-min d-cluster formation in wireless ad hoc networks,” in Proc. IEEE Conf. Comput. Commun., Mar. 2000, pp. 32–41.

[19] A. Manjeshwar and D. P. Agrawal, “Teen: A routing protocol for enhanced efficiency in wireless sensor networks,” in Proc. 15th Int. IEEE Parallel Distrib. Process. Symp., Apr. 2001, pp. 2009–2015.

[20] Z. Zhang, M. Ma, and Y. Yang, “Energy efficient multi-hop polling in clusters of two-layered heterogeneous sensor networks,” IEEE Trans. Comput., vol. 57. no. 2, pp. 231–245, Feb. 2008.