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A Survey: For Energy Efficient Clustering Routing Protocol Using Mobile Nodes in Wireless Sensor Networks

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Abstract Wireless Sensor Networks (WSN) consists of autonomous nodes which are static in nature and permanent in location for a lengthy period of time. The mobile WSN, having a unique features like limited resources and non-rechargeable batteries. Due to this constraints, the recent researches mainly focused to manage the energy consumption in order to extend the lifetime of the network. Nowadays, the WSN may consists of Heterogeneous and Mobile sensor nodes for many applications. For that, the important design issues are energy, scalability, production costs, data aggregation, fault tolerance, network lifetime, latency, node deployment, Quality of Service (QoS), mobility, throughput, packet delivery ratio and end to end delay etc. The advantage of allowing the sensors to be mobile increases the number of applications beyond those for which static WSNs are used.

Keywords Wireless Sensor Networks, Mobility, Clustering, Energy Consumption, Network Lifetime.

I. Introduction

A sensor network consists of a large number of small devices that have sensing, processing, and transmitting capabilities, that are powered by small batteries. Wireless Sensor Network performance is based on the cooperative effort of sensor nodes. Sensor nodes in a wireless sensor network are able to perform two jobs simultaneously namely sensing and communicating with the close by sensor nodes. In general, routing in WSNs can be based on Network Structure, based on Topology or Communication Model and Reliable Routing. Further routing protocols depending upon the network structure are divided into flat-based routing and hierarchical based routing protocols. Mobile wireless sensor network consists of a large number of autonomous sensor nodes that are densely deployed either inside the phenomenon or very close to it. Therefore energy efficiency in the design of routing protocols for wireless sensor networks (WSNs) is of paramount importance. The main contribution of this paper is a survey of various clustering routing protocols for the network lifetime improvement in data gathering.

II. Literature Survey

In [1] the paper deals with the problem of prolonging network lifetime in data gathering by employing a mobile Base Station. To achieved that, a device of novel clustering based heuristic algorithm for finding a trajectory of mobile base station that strikes the tradeoff between traffic load among sensor nodes and tour time constraint of mobile base station. The transmission range of each sensor node was fixed. The storage of a sensor node was limited, so that it cannot buffer large volume of data. All Cluster Head can be visited by mobile base station, where the length of BS tour was no longer than tour length. In addition, CH location affects the length of BS tour. The challenge of this problem was to find the optimal location of CH by jointly considered the BS tour and the network lifetime. Graham's Scanning algorithm was applied to find the set of boundary sensor nodes. It concluded that the simulation was performed against the BS case and evaluated the distribution of energy consumption among cluster heads.

In [2] the energy requirements due to the wireless transmission of data can be significantly reduced by the use of mobile elements. It act as a data transporter that roams in the network and collect data from sensors via short range communication. Thus the network lifetime increases by avoiding multihop communication. First a cluster based algorithm, groups the network into a number of balanced size clusters with a single caching point in each cluster and improved by alternating between the mobile element tour building phase and caching points forwarded tree computation phase. Second algorithm was solution with the objective of bounding the number of hops between nodes and the caching points. The split tree subroutine splits the tree into a collection of trees, so that each node has a path only to one caching point.

In [3] proposed to deployed multiple Mobile Base Station (MBS) to prolong the lifetime of the sensor network. Split the lifetime of the sensor node into equal period of time known as rounds. Base Station were relocated at the start of a round. It used an integer linear program to detect new location for the BS and a flow based routing protocol to

ensure energy efficiency routing during each round. The author attributed the nodes which were one hop away from a BS need to forward message originating from many other nodes, in addition to delivering their own message. To increase the lifetime of a sensor node, to employ multiple BS and periodically change their locations. Two strategies to choose BS location and compare the performance of these strategies with three other strategies. The protocol was based on flow information and concluded that using a rigorous application to optimized energy utilization leads to a significant increase in network lifetime.

In [4] a MBS collected data individually from each node using double fermat's spiral model. It proposed a system where deployed a robot as a BS into the network. The benefit of this was it moved on a predetermined path and it would collect data from various nodes scattered around the network. For energy consumption in nodes it used mathematical concepts. Nodes were placed arbitrarily in space for 3 level WSN and radial propagation strategy. The radial propagation WSN, the fermat's spiral or parabolic spiral were used. In 3 level WSN, the network divided into 3levels and 2^{nd} level act like an interface. It proved that better in energy efficient and very high data transmission throughput. BS was a MBS moving along a fixed path and nodes transfer the data directly to the moving BS and avoid the energy wastage and data dropping caused by gateway nodes.

In [5] the author proposed mobile node rotation, a new method for using low cost mobile sensor nodes to address differential power consumption and extend WSN lifetime. It proposed efficient algorithms for single and multiple rounds of rotations and to rotate the nodes through the high power consumption. Here presented a centralized node rotation algorithm NR1 to the 1-maxlife problem. A practical distributed algorithm DNR for the general max life problem used only local information and reduced the number of node movements. The performance was evaluated by NR1, CNR and DNR algorithm through simulations and the baseline was CNR-B algorithm. For each network, the routing tree from the sources to the sink was constructed using greedy geographic routing. It showed that the node rotation approach can improve the average lifetime by more than a factor of eight and it outperforms existing non-mobility approaches.

In [6] the author used with the enhancement of existing protocol for accommodated node mobility through neighboring node information while keeping the utilization of resources to a minimum. It was implemented by transmitting a message, which request for data transmission back to mobile sensor node from CH within a timeslot allocated in TDMA schedule. This protocol achieved definite improvement in data transfer success rates as mobile nodes. The sensor elected themselves to be local CH at any given time. Each sensor node determined to which cluster it wants by choosen the CH that requires minimum communication energy in LEACH-M. A node with rich energy level taken over the duty of CH in LEACH-ME and it maintained the information of node such as role, mobility factor, member list and TDMA schedule. The results outperformed LEACH-M in average successful communication rate, at very high mobility.

In [7] it described a distributed network protocol optimized for achieving the minimum energy for randomly deployed ad-hoc networks. A position based algorithm to set up and maintain a minimum energy network between users were deployed and allowed to move with random velocities. It denoted the mobile users by nodes over 2D plane. Here it does not assume a fixed and connected network topology. It introduced a protocol here was a self-reconfiguring in mobile network. Here one of the nodes to be the information sink for all the nodes called as the 'master-site'. A distributed network protocol found the minimum power topology for a stationary set of node with a master-site. The localized nature of search algorithm, proved to be an effective energy conserving protocol for the mobile case. The simulated performance of the protocol for mobile network was found that the average power consumption per node was low.

In [8] the paper proposed a cluster-based energy efficient scheme (CES) for electing a CH to evenly distribute energy consumption and obtain a longer network lifetime. In CES, each sensor calculated its weight based on k density, residual energy and mobility then it broadcasts to its 2-hop neighborhood. The protocol consists of grouping sensors into a set of disjoint clusters. Here the sensors were almost stable in a reasonable period of time during the clustering process. Weight represents the fitness of each node to be a CH, and the greatest weight meant highest priority. Each sensor was identified by a state vector and were responsible for maintained a table called cluster table. Finally the CES provided a better performance than LEACH and LEACH-C in terms of network lifetime and also for coverage and broadcasting.

In [9] a new controlled mobility model with an expected poly logarithmic number of relays to achieve a good balance included the delay, relay and distance. The model was based on each static node has short link connections whereas the long links were implemented using mobile nodes. The movement assisted model followed a store-carry-forward paradigm. It can be classified into random and controlled model. Here a combined random and controlled model was used. The poly logarithmic store-carry-forward model was based on the grid based model. Each grid was associated with an address. The grid form a cluster as a single node and defined the Manhattan distance between two nodes. It was assumed that there were atleast one static and dynamic node in each grid point. Each grid point, the 1 static node was act as a place holder. He intermediate nodes were called as free

riders. The simulation results were compared with the XY-direct, direct-S, and proposed PSCF with the basic settings in terms of delay, relay and distance and achieved a good performance.

In [10] the paper proposed the Energy Efficient Cluster Head Selection for Mobile WSN (EECHS-MWSN). Here the cluster head nodes were selected from the residual energy, low mobility factor and density of the node. The gateway node was act as an intermediate node to transfer data to the BS. The equations were used to calculate the transmission and receiving costs were formed by the BS on the basis of geographical locations of the sensors. The nodes formed in the cluster were not to be equal number in each of the cluster. The node to be selected as CH belongs to density area, residual energy and mobility within the cluster. Finally, the EECHS-MWSN was improved in comparison with the LEACH-Mobile protocol in terms of the throughput, energy consumption and network lifetime.

In [11] the mobility of sensor nodes posed a new challenge particularly in terms of energy consumption and packet loss. The different routing protocols showed various performances and maintained the routes in the network. LEACH performs self-organizing and re-clustering functions for every round only CH collects the data from all nodes and communicates to the sink. Mobile-LEACH involved the mobility of non CH nodes and CH during the set up and steady state phase. Next Mobile-Enhanced LEACH a node with minimum mobility factor was selected as a CH, if the residual energy of the node was not below the threshold value. CBR is an adaptive protocol that avoided the wastage of time slots and provided efficient bandwidth. Location aware fault tolerant clustering for mobile consists of a special packet was sent by a non CH node. It supported the sensor localization and a node moves to a new location without the location information. It summarized that the mobile WSN addressed the issues like energy efficiency, end to end delay to improve network lifetime.

In [12] the sensor nodes were deployed and divided into different clusters with different duties like gateway node, cluster head and ordinary sensor node. It introduced that the sensor nodes and sink were mobile which was hierarchical and cluster based in nature. The CH node forwards the data towards the gateway node inside the same cluster. Then the gateway node was responsible to transmit the data to the sink directly or via some other gateway node to the sink. Here the mobility of the nodes as well as the sink were managed at the gateway node. In the data forwarding phase, there was no need to check the network status periodically. The protocol was simulated in terms of throughput, network lifetime, average overhead, average energy consumption. Finally, it concluded that the protocol provided better result in comparison with LEACH protocol.

In [13] the designing of energy efficient and reliable routing protocols is a great challenge task in the resource environment. So the author proposed an Energy Efficient Density Based Clustering for Mobile node (EEDBC-Mobile) and the cluster formation was based on DBSCAN algorithm. The inputs required for the algorithm were radius and the minimum nodes required inside the cluster. The two kinds of nodes mentioned here are core and border nodes. Neither core nor border nodes in the cluster were marked as noise node. The core node initiates a clustering process and the nearby nodes will be added in the queue for next process. DBSCAN algorithm could merge the two clusters into one cluster, if the two clusters of different densities were close to each other. The CH received the sensed data from the other nodes in the cluster and made a data aggregation function. Then the CH maintained a table in which it recorded the node with maximum power at current round. This algorithm evaluated the performance in terms of average energy consumption, throughput, average end to end delay, packet delivery ratio and network lifetime. The simulated results showed that EEDBC-Mobile provided better performance when compared to LEACH, LEACH-Mobile and LEACH-Mobile Enhanced.

In [14] Energy Efficient is an essential aspects in Mobile WSN. The paper compared the clustering protocols like LEACH, M-LEACH, ME-LEACH and CBR-MWSN to analyzed the performance. The system model randomly deployed the sensor nodes and the BS was far away from the network was fixed. Here the links were symmetric. The idea of LEACH-Mobile was the cluster move and confirm whether the mobile sensor node was able to communicate with a specific CH. Then it transmits a message back to sensor node from CH within a TDMA schedule. If the data doesnot receive within the timeslot, then a join-request message was sent to the next TDMA schedule. Whereas in LEACH-ME, the node with minimum mobility factor was elected as a CH. Finally, it consumed more energy to calculate the mobility factor of each node. In CBR-MWSN, one of the CH's must be free to received the packet from the lost node in which cannot receive data request message. Due to that, the data loss was reduced by sending the data to new free CH and join acknowledgement message to the CH's. The results showed that LEACH-ME greatly prolonged the network lifetime than the other protocols.

In [15] proposed a location based energy aware reliable routing protocol (LEAR) based on sensor position and clustering. It is not only energy efficient but also reliable. The advantage of location information to made the routing mechanism more efficient in LEAR. Here, each node sent their location co-ordinates to its neighbors. A special packet is sent by a non-CH node A if A has no sensed data to send to the CH at its allocated timeslot and thus, saves energy by not sending data at every timeslot. special packets allow the LFCP-MWSN protocol to detect the mobility and failure of member nodes of a cluster. Moreover, LFCP-MWSN

detects the failure of sensor nodes. Finally, simulation results showed that LFCP-MWSN protocol was more efficient in terms of energy consumptions, network lifetime and data transmissions than those of the other protocols.

In [16] It proposed an Efficient Cluster Based Self-Organization Algorithm (ECSA) to divide the network into clusters, whose weight was based on its k-density and residual energy. The balanced cluster was generated with size ranges between the two thresholds and depends on network topology. Here the weight denoted the fitness of sensor to be CH whereas higher weight represented higher priority. The algorithm was generated to reduced the number of stable and balanced clusters. At the beginning, each sensor calculated its weight and generated a hello message included two extra fields namely weight and node CH, where node CH was set to zero. The clustering process was performed in set-up and re-affiliation phase. In set-up phase, the size of the cluster was less than lower threshold whereas in the re-affiliation it will be triggered. The simulation results were carried out in comparison with the LEACH and LEACH-C in terms of number of clusters formed and data packets received at the BS. Finally, it proved that ECSA provided better performance than other two protocols.

In [17] The selection of routing strategies was an important factor for the efficient delivery of packets to their respective destinations. The set-up procedure of LEACH-M is same as that of basic LEACH protocol. In this procedure, communication of a node with the cluster-head is possible even if that node is in motion. It could be appropriate for mobility-centric routing protocol in wireless sensor network. LEACH-Mobile-Enhanced routing protocol which is the enhancement of LEACH-MOBILE routing protocol. Selected cluster head sends the data request to the respective nodes in their TDMA time slot. Data request is sent with the active flag as zero if there is no ACTIVE slot in the TDMA slot. In Location-Aware Fault Tolerant Clustering protocol the sensors are localized using the range free localization technique. A sensor node was assigned to a cluster whose cluster-head is at the minimum distance from that node. If cluster-head does not receive any frame then cluster-head waits until the next timeslot so that the transmission failure for that node is confirmed. In MECA, network is grouped into several equal clusters. CH is selected based on the residual energy that collects data and sends it to the mobile sink. Sink either moves clockwise or counter clockwise. Initially mobile sink is deployed at the edge of the sensing field that moves along a fixed track and is predictable.

Protocol Used	**Delay**	**Throughput**	**Distance**	**Packet Delivery Ratio**	**Relay**	**Energy Consumption**	**Network Lifetime**
Novel Clustering						✓	✓
Cluster Based Energy Efficient Scheme	✓	✓				✓	✓
Model Based Poly logarithmic Routing	✓		✓		✓		✓
Energy Efficient Cluster Head Selection		✓				✓	✓
Mobile-Enhanced LEACH	✓					✓	✓
Energy Efficient Routing Clustering	✓	✓				✓	
Enhancement of Energy Efficient Density Based Clustering for Mobile	✓	✓		✓		✓	✓
Flow Based				✓		✓	✓

Routing							
Location Based Energy Aware Reliable Routing	✓			✓		✓	✓
Efficient Cluster Based Self-Organization Algorithm				✓		✓	✓

Table 1 Comparisons of various clustering routing protocols with their parameters.

III. Conclusion

Routing is a key performance metric for various applications in WSNs. This paper reviewed the various routing protocols for a Mobile-WSN. The different routing protocols solve this problem and produce scalable and efficient solutions. They divide the whole network into clusters, efficiently maintain the energy consumption of sensor nodes, and perform data aggregation and in order to decrease the number of transmitted messages to the sink. Thus, the various routing protocols are suited for sensor networks for different applications and wide coverage area. They not only improve the routing process but also improve network lifetime, scalability and reliability at the same time.

References

[1]Oday Jerew, Weifa Liang Prolonging Network Lifetime Through the Use of Mobile Base Station in Wireless Sensor Networks Proceedings of MoMM2009 MoMM 2009 Full Papers.
[2]Tour and Path Planning Methods for Efficient Data Gathering using Mobile Elements International Journal of Ad Hoc and Ubiquitous Computing, Vol. 0, No. 00, 2014 Khaled Almi'ani, Anastasios Viglas, Lavy Libman.
[3]Energy Efficient Schemes for Wireless Sensor Networks with Multiple Mobile Base Stations Shashidhar Rao Gandham, Milind Dawande, Ravi Prakash and S. Venkatesan International Journal of Scientific Research Engineering & Technology (IJSRET) Volume 2 Issue4 pp 226-231 July 2013 www.ijsret.org ISSN 2278 – 0882.
[4]Energy Efficiency Mechanisms Using Mobile Node in Wireless Sensor Networks Teddy Mantoro, Media A. Ayu, Haroon Shoukat Ali, Wendi Usino, and Mohammed M. Kadhum, R. Benlamri (Ed.): NDT 2012, Part I, CCIS 293, pp. 536–550, 2012© Springer-Verlag Berlin Heidelberg 2012.
[5]Maximizing Network Topology Lifetime using Mobile Node Rotation, Fatme El-Moukaddem, Eric Torng Guoliang Xing.
[6] Routing Protocol Enhancement for handling Node Mobility in Wireless Sensor Networks G. Santhosh Kumar, Vinu Paul M V, G. Athithan and K Poulose Jacob.
[7]Minimum Energy MobileWireless Networks Volkan Rodoplu, and Teresa H. Meng IEEE Journal on Selected Areas in Communications, VOL. 17, NO. 8, AUGUST 1999.
[8]Lehsaini M., Guyennet H. and Feham.M, CES: Cluster-based Energy-efficient Scheme for Mobile Wireless Sensor Networks, 2008, in IFIP International Federation for Information Processing, Volume 264; Wireless Sensor and Actor Networks II; Ali Miri; (Boston: Springer), pp. 13–24.
[9]Wu J, Yang SH. Small world model-based polylogarithmic routing using mobile nodes. Journal of Computer Science and Technology 23(3): 327{342 May 2008.
[10]Mrs.R.U.Anitha Dr.P.Kamalakkannan Energy Efficient Cluster Head Selection Algorithm in Mobile Wireless Sensor Networks 2013 International Conference on Computer Communication and Informatics (ICCCI -2013), Jan. 04 – 06, 2013, Coimbatore, INDIA.
[11]Ravinder Kaur, Dr.Trilok Chand Aseri Routing Protocols for Mobile Wireless Sensor Networks International Journal of Software and Web Sciences (IJSWS).
[12]Vishak.S.k Geetha Ramani.J Energy Efficient Routing in Wireless Sensor Networks International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 4, April 2013.
[13]]Mrs.R.U.Anitha Dr.P.Kamalakkannan EEDBC-M:Enhancement of Leach-Mobile protocol with Energy Efficient Density-based Clustering for Mobile Sensor Networks (MSN) International Journal of Computer Applications (0975-8887) Volume 74, No.14, July 2013.
[14]Mrs.R.U.Anitha Dr.P.Kamalakkannan Performance Evaluation Of Energy Efficient Cluster Based Routing Protocols In Mobile Wireless Sensor Networks International Journal of Engineering Science and Technology.
[15]Divya Mittal, Sukhjinder Kaur Enhanced Location-Aware Routing Protocol for Wireless Sensor Network International Journal of Science and Modern Engineering (IJISME) ISSN: 2319-
6386, Volume-1, Issue-12, November 2013.
[16]Mohamed Lehsaini and Hervé Guyennet, Mohammed Feham An efficient cluster-based self-organisation algorithm for wireless sensor networks Int. J. Sensor Networks, Vol. 7, Nos. 1/2, 2010.
[17]Routing Protocols for Mobile Wireless Sensor Networks Ravinder Kaur, Dr.Trilok Chand Aseri International Journal of Software and Web Sciences (IJSWS) 2013.
[18]Sensor Networks: Evolution, Opportunities, and Challenges

CHEE-YEE CHONG, AND SRIKANTA P. KUMAR, PROCEEDINGS OF THE IEEE, VOL. 91, NO.8, AUGUST 2003.
[19]Mobility Metric based LEACH-Mobile Protocol G. Santhosh Kumar, Vinu Paul M V, K. Poulose Jacob © 2008 IEEE.
[20]A Survey on Routing Protocols for Wireless Sensor Networks Kemal Akkaya and Mohamed Younis.
[21]Wu J, Yang S, Dai F. Logarithmic store-carry-forward routing in mobile ad hoc networks. *IEEE* Transactions on Parallel and Distributed Systems, 2007, 18(6): 735-748.
[22]Liliana M. Arboleda C.and Nidal Nasser, Cluster-based Routing Protocol for Mobile Sensor Networks, *QShine'06*, The Third International Conference on Quality of Service in Heterogeneous Wired/Wireless Networks, August 7–9, 2006, Waterloo, Ontario,Canada © 2006 ACM 1-59593-472-3/06/08.
[23]Do-Seong Kim, Yeong-Jee Chung, Self-Organization Routing Protocol Supporting Mobile Nodes for Wireless Sensor Network, Proceedings of the First International Multi-Symposiums on Computer and Computational Sciences (IMSCCS'06), 2006.
[24]Lutful Karim and Nidal Nasser Energy efficient and Fault Tolerant Rouing protocol for mobile Sensor Network, IEEE ICC 2011 proceedings.
[25]Razieh Sheikhpour, Sam Jabbehdari and Ahmad Khadem-Zadeh Comparison of Energy Efficient Clustering Protocols in Heterogeneous Wireless Sensor Networks International Journal of Advanced Science and Technology Vol. 36, November, 2011.