Improving Network Lifetime In MANET Using VGDRA

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Abstract

A virtual grid based dynamic routes adjustment scheme for mobile sink based wireless sensor networks was introduced in recent times. Routing is defined as moving of information from source to destination. As in virtual gridding protocol, the cluster head was chose once the communication started due to this after the energy of the node is consumed the communication stopped thereby decreasing the network life time. So in this proposed work the cluster head is selected after energy of the current cluster head is utilized, in this case a threshold value is set. The problem of straight line communication is also considered, as the sink is kept mobile the nodes that are far away from the sink consume more energy and time for communication process as the distance between the sink and node is quite large so to resolve the problem a rechargeable node employed at the centre of the grid. This node is used for the direct straight line communication with the sink thus consuming the less amount of energy as these are rechargeable nodes. By using this routing concept, the energy of the system will be decreased that will result in increasing the life time and the stability of the network. Therefore this method of routing is considered to be better and more efficient than the traditional algorithm of routing.

Keywords: Routes reconstruction, energy efficiency, MANET, wireless sensor networks.

Introduction

A wireless sensor network (WSN) (sometimes called a wireless sensor and actor network are spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding.

Routing is the process of selecting best paths in a network. In the past, the term routing was also used to mean forwarding network traffic among networks. However this latter function is much better described as simply forwarding. Routing is performed for many kinds of networks, including the telephone network (circuit switching), electronic data networks (such as the Internet), and transportation networks. This article is concerned primarily with routing in electronic data networks using packet switching technology.

With the advances of wireless communication technology, low-cost and powerful wireless transceivers are widely used in mobile applications. Mobile networks have attracted significant interests in recent years because of their improved flexibility and reduced costs.

Compared to wired networks, mobile networks have unique characteristics. In mobile networks, node mobility may cause frequent network topology changes, which are rare in wired networks. In contrast to the stable link capacity of wired networks, wireless link capacity continually varies because of the impacts from transmission power, receiver sensitivity, noise, fading and interference. Additionally, wireless mobile networks have a high error rate, power restrictions and bandwidth limitations. Mobile networks can be classified into infrastructure networks and mobile ad hoc networks according to their dependence on fixed infrastructures. In an infrastructure mobile network, mobile nodes have wired access points (or base stations) within their transmission range. The access points compose the backbone for an infrastructure network. In contrast, mobile ad hoc networks are autonomously self-organized networks without infrastructure support. In a mobile ad hoc network, nodes move arbitrarily, therefore the network may experiences rapid and unpredictable topology changes. Additionally, because nodes in a mobile ad hoc network normally have limited transmission ranges, some nodes cannot communicate directly with each other. Hence, routing paths in mobile ad hoc networks potentially contain multiple hops, and every node in mobile ad hoc networks has the responsibility to act as a router.

The Wireless Routing Protocol (WRP)

The Wireless Routing Protocol (WRP) is a proactive uncast routing protocol for mobile ad hoc networks. WRP uses improved Bellman-Ford Distance Vector routing algorithm. To adapt to the dynamic features of mobile ad hoc networks, some mechanisms are introduced to ensure the reliable exchange of update messages and reduces route loops.

Using WRP, each mobile node maintains a distance table, a routing table, a link-cost table and a Message Retransmission List (MRL). An entry in the routing table contains the distance to a destination node, the predecessor and the successor along the paths to the destination, and a tag to identify its state, i.e., is it a simple path, a loop or invalid. Storing predecessor and successor in the routing table helps to detect routing loops and avoid counting-to-infinity problem, which is the main shortcoming of the original distance vector routing algorithm. A mobile node creates an entry for each neighbor in its link-cost table. The entry contains cost of the link connecting to the neighbor, and the number of timeouts since an error-free message was received from that neighbor.

The Destination Sequence Distance Vector (DSDV) routing protocol

The Destination Sequence Distance Vector (DSDV) is a proactive unicast mobile ad hoc network routing protocol. Like WRP, DSDV is also based on the traditional Bellman-Ford algorithm. However, their mechanisms to improve routing performance in mobile ad hoc networks are quite different.

In routing tables of DSDV, an entry stores the next hop towards a destination, the cost metric for the routing path to the destination and a destination sequence number that is created by the destination. Sequence numbers are used in DSDV to distinguish stale routes from fresh ones and avoid formation of route loops.

The Dynamic Source Routing (DSR) Protocol

The Dynamic Source Routing (DSR) is a reactive uncast routing protocol that utilizes source routing algorithm. In source routing algorithm, each data packet contains complete routing information to reach its dissemination. Additionally, in DSR each node uses caching technology to maintain route information that it has learnt.

There are two major phases in DSR, the route discovery phase and the route maintenance phase. When a source node wants to send a packet, it firstly consults its route cache. If the required route is available, the source node includes the routing information inside the data packet before sending it. Otherwise, the source node initiates a route discovery operation by broadcasting route request packets. A route request packet contains addresses of both the source and the destination and a unique number to identify the request. Receiving a route request packet, a node checks its route cache. If the node doesn't have routing information for the requested destination, it appends its own address to the route record field of the route request packet. Then, the request packet is forwarded to its neighbors. To limit the communication overhead of route request packets, a node processes route request packets that both it has not seen before and its address is not presented in the route record field. If the route request packet reaches the destination or an intermediate node has routing information to the destination, a route reply packet is generated. When the route reply packet is generated by the destination, it comprises addresses of nodes that have been traversed by the route request packet. Otherwise, the route reply packet comprises the addresses of nodes the route request packet has traversed concatenated with the route in the intermediate node's route cache.

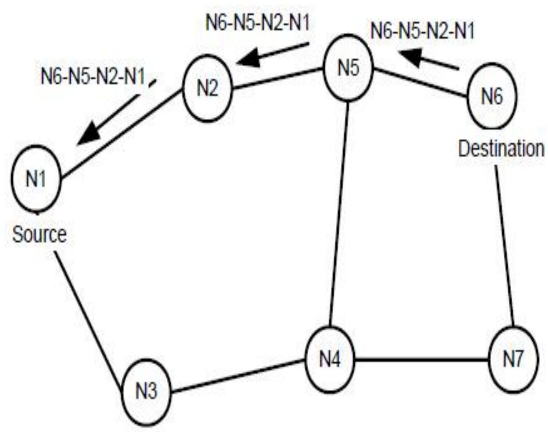


Fig. 1. Route Reply with route record in DSR

After being created, either by the destination or an intermediate node, a route reply packet needs a route back to the source. There are three possibilities to get a backward route. The first one is that the node already has a route to the source. The second possibility is that the network has symmetric (bi-directional) links. The route reply packet is sent using the collected routing information in the route record field, but in a reverse order as shown in Figure 1. In the last case, there exists asymmetric (uni-directional) links and a new route discovery procedure is initiated to the source. The discovered route is piggybacked in the route request packet.

In DSR, when the data link layer detects a link disconnection, a ROUTE_ERROR packet is sent backward to the source. After receiving the ROUTE_ERROR packet, the source node initiates another route discovery operation. Additionally, all routes containing the broken link should be removed from the route caches of the immediate nodes when the ROUTE_ERROR packet is transmitted to the source.DSR has increased traffic overhead by containing complete routing information into each data packet, which degrades its routing performance.

The Ad Hoc On-demand Distance Vector Routing (AODV) protocol

The Ad Hoc On-demand Distance Vector Routing (AODV) protocol is a reactive unicast routing protocol for mobile ad hoc networks. As a reactive routing protocol, AODV only needs to maintain the routing information about the active paths. In AODV, routing information is maintained in routing tables at nodes. Every mobile node keeps a next-hop routing table, which contains the destinations to which it currently has a route. A routing table entry expires if it has not been used or reactivated for a pre-specified expiration time. Moreover, AODV adopts the destination sequence number technique used by DSDV in an on-demand way.

In AODV, when a source node wants to send packets to the destination but no route is available, it initiates a route discovery operation. In the route discovery operation, the source broadcasts route request (RREQ) packets. A RREQ includes addresses of the source and the destination, the broadcast ID, which is used as its identifier, the last seen sequence number of the destination as well as the source node's sequence number. Sequence numbers are important to ensure loop-free and up-to-date routes. To reduce the flooding overhead, a node discards RREQs that it has seen before and the expanding ring search algorithm is used in route discovery operation. The RREQ starts with a small TTL (Time-To-Live) value. If the destination is not found, the TTL is increased in following RREQs.

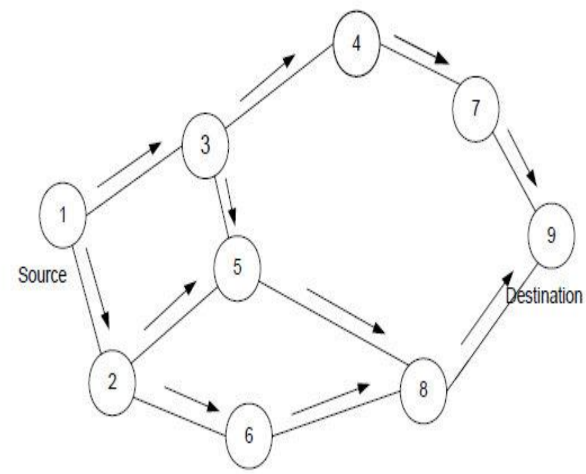


Fig. 2. The Route Request packets flooding in AODV

In AODV, each node maintains a cache to keep track of RREQs it has received. The cache also stores the path back to each RREQ originator. When the destination or a node that has a route to the destination receives the RREQ, it checks the destination sequence numbers it currently knows and the one specified in the RREQ. To guarantee the freshness of the routing information, a route reply (RREP) packet is created and forwarded back to the source only if the destination sequence number is equal to or greater than the one specified in RREQ. AODV uses only symmetric links and a RREP follows the reverse path of the respective RREP. Upon receiving the RREP packet, each intermediate node along the route updates its next-hop table entries with respect to the destination node. The redundant RREP packets or RREP packets with lower destination sequence number will be dropped.

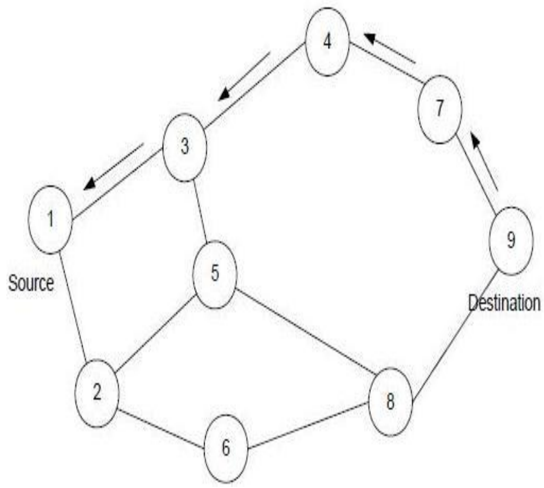


Fig. 3. The forwarding of Route Reply packet in AODV

In AODV, a node uses hello messages to notify its existence to its neighbors. Therefore, the link status to the next hop in an active route can be monitored. When a node discovers a link disconnection, it broadcasts a route error (RERR) packet to its neighbors, which in turn propagates the RERR packet towards nodes whose routes may be affected by the disconnected link. Then, the affected source can re-initiate a route discovery operation if the route is still needed.

Related Work

As we know that for formation of network we need to find the route between all the nodes coming in the network, for this purpose routing is done. Routing is defined as moving of information from source to destination. Along the way, at least one intermediate node is encountered. It can be referred as medium for sending packets from source and destination. Previously the routing was done on the basis of the minimum distance from the sink. Later the virtual gridding protocol was introduced. GRID is a two-level hierarchical reactive routing protocols. The main idea of GRID is that a geographic area is partitioned into several logic grids and the gateway election is held in each grid. A number of mobile nodes may exist in each grid. In traditional approach the cluster head is selected only once in the start of the communication after that the cluster head remain static but due this when the cluster head node died the communication stopped. This decrease the efficiency of the network. Another major problem of using this traditional protocol is that the node that are located far from the sink choose long route for the communication , that results in increase in the distance and the energy consumption was more.. So there is a need to find some solution for the problem for the efficient routing in the network.

Proposed Work

Routing is defined as moving of information from source to destination. For efficient network the routing protocol that is used should consume less energy, and less distance. As in virtual gridding protocol, the cluster head was chose once the communication started due to this after the energy of the node is consumed the communication stopped thereby decreasing the network life time. So in this proposed work the cluster head is selected after energy of the current cluster head is utilized, in this case a threshold value is set , this threshold value set is used for the cluster head selection process . After the start of every round the energy of the cluster head is compared with the threshold, if the energy is less than the next node near to it is selected as the cluster head. In this way the stability of the network increases. The problem of straight line communication is also considered, as the sink is kept mobile the nodes that are far away from the sink consume more energy and time for communication process as the distance between the sink and node is quite large so to resolve the problem a rechargeable node employed at the centre of the grid. This node is used for the direct straight line communication with the sink thus consuming the less amount of energy as these are rechargeable nodes By using this routing concept, the energy of the system will be decreased that will result in increasing the life time and the stability of the network. Therefore this method of routing is considered to be better and more efficient than the traditional algorithm of routing.

Result Analysis

In this section, we present the simulation results using MATLAB. We varied the total number of sensor nodes from 100 to 400 which are randomly deployed in a sensor field of 200 × 200 dimension. A mobile sink moves around the sensor field counterclockwise and periodically broadcasts hello packets. Initially all the sensor nodes have uniform energy reserve of 1 mJ. Furthermore, we considered nodes energy consumption in transmission (Tx) and receiving (Rx) modes only which are computed using Equation 1 and 2 respectively.

$$Tx=(Eelect\times K)+(Eamp\times K\times d^2) \quad (1)$$

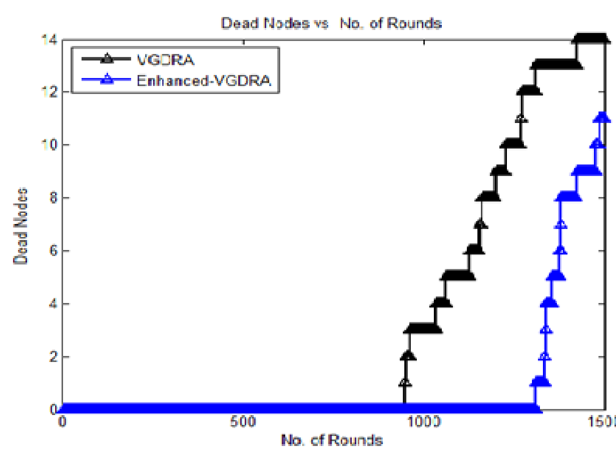
$$Rx=Eelect\times K \quad (2)$$

In Equation 1 and 2, K is the message length, Eelect is the node’s energy dissipation in order to run its radio electronic circuitry and Eamp is the energy dissipation by the transmitter amplifier to suppress the channel noise. In our experiment, we took Eelect = 50 nJ, and Eamp = 10 nJ/bit/m2 and K = 8*2 bits. We considered the nodes communication cost in adjusting the data delivery routes only, whereas the actual data delivery is beyond the scope of this paper. We compared our enhanced VGDRA scheme with VGDRA where a common feature among them is the use of a virtual infrastructure for network operation.

SIMULATION RESULTS

Network Life Time

In this figure, When a node is dead in the network it’ll not be the part of the network. It shows that if a dead node occurs in early rounds of the algorithm, this may affect lifespan of the network or drag towards the early dead of all nodes. The first node dies later in the network. The number of dead nodes at round 1500 is 14 in VGDRA whereas they are coming to be 11 in Enhanced VGDRA. There is decrement in number of dead nodes making the network processing time longer thereby increasing the network lifetime of sensor network. Both the plots of alive nodes and dead nodes are vice-versa to each other.



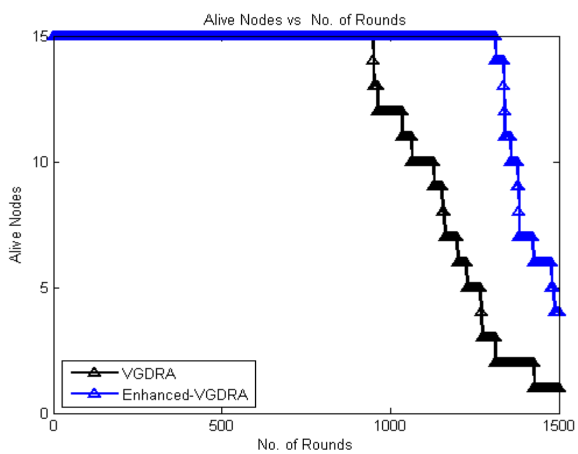
Network Life Time (Dead nodes) vs no. of rounds

Alive Nodes Vs Number of Rounds

More alive nodes contribute to the increase in network life time. The number of nodes alive in the network with the increase in number of rounds. we show the simulation results of number of alive nodes. At round 1500, number of alive nodes are 1 in VGDRA whereas this number has increased to 4 in case of Enhanced VGDRA. Greater the number of alive nodes greater is the lifetime of network.

Network Life Time with Number of Alive nodes

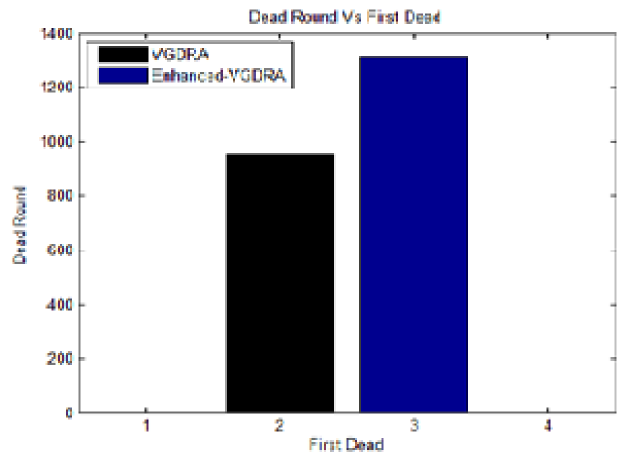
No. of Rounds	VGDRA	Enhanced VGDRA
0-500	15	15
500-1000	12	15
1000-1500	1	4



Comparing the alive nodes vs no. of rounds

Stability Period (First Node Dead)

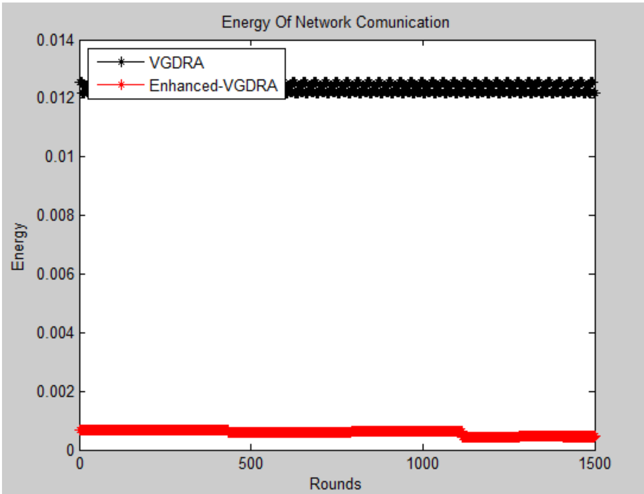
It shows the comparison of first dead node of our Enhanced VGDRA scheme with virtual grid routing scheme and it can be seen from the figure that first dead node of old result i.e. virtual grid routing is earlier than our new results i.e.by using distance enhancing grid routing scheme which means that by using our approach the nodes will become dead after more rounds as compare to virtual grid routing approach. It is defined as the time interval between start of network operation till the death of first sensor node. Later the first dead node comes, greater the stability period. Simulation results of first node dead are shown in figure 5.2.3. The first node coming to be dead at about 950 in VGDRA whereas it is becoming dead at 1300 in Enhanced VGDRA. The first node in Enhanced VGDRA dies after 350 processing rounds as compared to VGDRA.



Dead round vs First node dead

Energy of Network Communication

The comparison of energy of our Enhanced VGDRA scheme with virtual grid routing scheme. It is shown that energy consumption in Enhanced VGDRA scheme is very less than the virtual grid routing scheme because of improvement in distance of network communication.



Comparing energy of network communication

Conclusion

The path of transfer of data between the source and the destination is termed as Routing. For efficient network the routing protocol that is used should consume less energy, and less distance. In this propose work the rechargeable nodes are introduced. Form the results obtained it is concluded that the thus proposed protocol is better and more efficient than the traditional routing protocol. The energy consumption of the nodes is decreased and the network life time is increased. Also the comparison between the proposed and the traditional algorithm is done that show this method is efficient than the traditional method.

FUTURE SCOPE

The results obtained by using proposed method are considered to be efficient and better than the traditional algorithm. In future this method of routing can be further enhanced to obtain more efficient results by enhancing route selection method. The efficient routing should increase the life time of network and the energy consumption of the network is reduced. . In future this technique can be further enhanced. The selection of the route should be done in the more efficient way so that the energy consumption of the network is reduced and the life time of the network is improved.

References

1. Aayushi Mahajan, Suhaib Ahmed, Swastik Gupta, Ashish Suri (April, 2014) “Comparative Analysis of Different Data Dissemination Strategies in Wireless Sensor Networks”, IJARCCE, Vol. 3, Issue 4, pp 6350-6354.

2. Abdul Waheed Khan, Abdul Hanan Abdullah, Mohammad Abdur Razzaque, Javed Iqbal Bangash,and Ayman Altameem (August, 2015) “VGDD: A Virtual Grid Based Data Dissemination Scheme for Wireless Sensor Networks with Mobile Sink”, International Journal of Distributed Sensor Networks Volume 2015, pp 1-17.

3. Adnan Fida, Muhammad Iqbal and Trung Dung Ngo (2December,2014) **“**Communication- and position-aware reconfigurable route optimization in large-scale mobile sensor networks**,”** EURASIP Journal on Wireless Communications and Networking20142014:207 ,DOI: 10.1186/1687-1499-2014-207.

4. A. Manjeshwar ; D. P. Agrawal (2002) “APTEEN: A Hybrid Protocol for Efficient Routing and Comprehensive Information Retrieval in Wireless Sensor Networks∗”, IEEE, Proceedings of the International Parallel and Distributed Processing Symposium (IPDPSí02).

5. Amith Khandakar (2012) “Step by Step Procedural Comparison of DSR, AODV and DSDV Routing protocol”, IPCSIT, Vol:40, pp 36-40.

6. Arun A. Somasundara; Aditya Ramamoorthy; Mani B. Srivastava (2004) “Mobile Element Scheduling for Efficient Data Collection in Wireless Sensor Networks with Dynamic Deadlines”, 25th IEEE, RTSS 2004.

7. Awadhesh kumar Dr. Neeraj Tyagi , Prabhat Singh , Vinay Kumar (April, 2013) “A Novel Energy Aware Data Dissemination Routing Protocol for WSN,” IJAIEM, Volume 2, Issue 4, April 2013.

8. Cho, J.; Choe, J.; Song, K. & Shin, Y. (Jan, 2009) “A routing protocol using relative landmark based on virtual grid in wireless sensor network”, IEEE, pp 1**-3.**

9. Dattatray S. Waghole, Vivek S. Deshpande (March, 2013) “Reducing Delay Data Dissemination Using Mobile Sink in Wireless Sensor Networks”, IJSCE, Volume-3, Issue-1, pp 305-308.

10. Dinu Gopal and Dr. Suriyakala C D (July, 2015) “A Survey on Performance Comparison of Virtual Structure based Data Dissemination Schemes in WSN,” JNCET, Volume 3, Issue 1.

11. Donghyun Kim, Baraki H. Abay ; R. N. Uma ; Weili Wu (2012) “Minimizing data collection latency in wireless sensor network with multiple mobile elements”, IEEE, INFOCOM, 2012 Proceedings IEEE, pp 504-512.

12. Ehsan Ahvar, Shohreh Ahvar, Gyu Myoung Lee, and Noel Crespi (13 february,2014) “An Energy-Aware Routing Protocol for Query-Based Applications in Wireless Sensor Networks,” The Scientific World Journal, Article ID 359897, 9 pages.

13. Elyes Ben Hamida, Guillaume Chelius (2008) “Strategies for Data Dissemination to Mobile Sinks in Wireless Sensor Networks”, IEEE communication. magazine, Feb. 2008.

14. Jin Wang, Xiaoqin Yang, Zhongqi Zhang, Bin Li and Jeong-Uk Kim (2014) “A Survey about Routing Protocols with Mobile Sink for Wireless Sensor Network”, International Journal of Future Generation Communication and Networking Vol.7, No.5 (2014), pp.221-228.

15. Kai Li, Kien A.Hua (2012) “Mobile Data Collection Networks for Wireless Sensors”, Springer, vol: 287, pp 200-211.

16. Kumar, S.; Sengupta , J. (Spetember, 2010) “AODV and OLSR routing protocols for Wireless Ad-hoc and Mesh Networks”, IEEE, pp 402-407.

17. Liang He , Jianping Pan , and Jingdong Xu (December 2011) "Analysis on Data Collection with Multiple Mobile Elements in Wireless Sensor Networks".
18. Marcello Caleffi, Giancarlo Ferraiuolo, and Luigi Paura "Augmented Tree-based Routing Protocol for Scalable Ad Hoc Networks", IEEE.
19. MARIO DI FRANCESCO, SAJAL K. DAS CReWMaN, GIUSEPPE ANASTASI (2011) "Data Collection in Wireless Sensor Networks with Mobile Elements: A Survey", ACM Trans. Sensor Netw., vol. 8, no. 1, pp. 1–31.
20. Ms.Rubia.R and Mr.SivanArulSelvan, (Jan, 2014) "A Survey on Mobile Data Gathering in Wireless Sensor Networks - Bounded Relay", IJETT, Volume 7 Number 5, pp 205-208.