A Novel Data Collection Scheme in Wireless Sensor Networks Using MASP

Reddy Bharath Kumar D, CH.Nagaraju

Abstract: In wireless sensor networks the energy efficiency can be improved with path constrained sink mobility. But collecting data from the nodes deployed randomly by the mobile sink as limited communication time due to constant speed of the mobile sink in the path constrained approach. This affects the amount of data collected and the energy consumption of the network. To overcome this issue, a novel data collection scheme called MASP is proposed. MASP is implemented as a two phase communication protocol base on zone partition. Our results are validated and simulated using OMNET++. .

Index Terms: Mobile Sink, Path Constrained, STP, Wireless Sensor Network (WSNs).

I. INTRODUCTION

In the field of communication, wirelesses Sensor Networks (WSNs) are one of the most promising solutions. A WSN consists of a number of small sensor nodes deployed over a sensing field. Each node is a device capable of sensing physical information from the surrounding environment (e.g., temperature, pressure and vibrations), processing the acquired data locally, and sending them to one or more collection points, referred to as Sink .sink mobility as became an important topic in wireless sensor networks. Sink mobility along a constrained path improves the performance of the WSNs [1],[2],[3]. In sink mobility scenarios, the communication area as divided into two types as direct communication area(DCA) and multi hop communication area (MCA).The sensors within the DCA are called as sub-sinks and can directly communicate with the mobile sink whereas nodes in MCA are called as members and they depends on sub-sinks to communicate with the mobile sink. In path predicted scenarios shortest path tree (SPT) method is proposed to route data choosing cluster heads. Mobiroute routing protocol [5] in which all sensor nodes need to be aware of the mobile sink is suggested in STP method. In the STP method only the hop distance between the sub-sink and members are considered and the communication time between the sub-sink and mobile sink is not considered. If sub-sink with less communication time as large number of members than it results in loss of gathering data by the mobile sink from the sub-sinks. On the other hand if the sub-sink as large communication and small number of members are routed to it than energy will be wasted. This STP method results in low energy efficiency for data collection. To overcome this data collection scheme called Maximum Amount Shortest Path is proposed

In this paper we are proposing Maximum Amount Shortest path (MASP), method in which energy efficiency is improved along with the data collection in the wireless sensor networks. In MASP method communication time of the sub-sink with the mobile sink is considered where as in SPT method only the hop distance between the sub-sink and mobile sink is considered. To implement the MASP method we are designing a two phase communication protocol based on zone partition and the impact of zone partition on energy utilization efficiency is studied. We also conducted simulation experiments using OMNET++ [7], the results are validated and shows that MASP scheme outperforms SPT in terms of the data collected and energy efficiency.

II. TWO PHASE COMMUNICATION PROTOCOL

The two phase communication protocol is implemented in the following phases

A. *Data discover phase*

In discover phase main task is to learn the topology information and assigning the members to their corresponding sub-sinks.the discover phase is done in three different rounds

Round 1:

In round 1, the mobile sink transmits broadcast messages continuously. All nodes which are receiving the broadcast messages from the mobile sinks are automatically selected as sub sinks. Then the sub sinks start building the shortest path trees (SPTs) rooted from themselves in entire network. Then each node obtains the shortest hop information from themselves to all sub-sinks and the related hop information is send to the corresponding sub-sink. Mobile sink records the time when each node enters and leaves the communication range this is an important task in round 1.

Round 2:

In round 2, shortest hop information collected in round 1 is send to the mobile sink by the sub-sinks when the mobile sink passes by. The mobile sink calculates the communication time of the each sub-sink according to the overlap time partition.

Round 3:

In this round, the mobile sink transverse the trajectory again to broadcast the results to members' assignment to the monitored area. The broadcast message consists of the list of the mapping relation between member and its destination sub-sink. Each node receiving the broadcast message will get sub sin as its destination.

Revised Manuscript Received on 30 June 2012.
* Correspondence Author
Reddy Bharath Kumar D, Department of ECE, AITS, Rajampet, (A.P), India.
CH.Nagaraju, Department of ECE, AITS, Rajampet (A.P), India.

Then the node will delete its own item in the broadcast message and rebroadcast it. Finally, the optimized member assignment information will be disseminated to the entire network.

B. *Data collection phase*

In the data collection phase, all nodes in the monitored area start collecting data formally. The sensed data from members sends it to the destination sub-sink according to the routing table built in round 1 of the discovery phase sub-sinks pre-cache all data from their members and themselves before the mobile sink enters into their communication range. During the actual data collection, we adopt a handoff method to partition the overlapping time which is consistent with the one used in Round 2. In order to load balance the data originated from members, a round bin scheme [6] is used to transmit data at the sub-sinks. In this paper, the constraints on the network throughput are expressed by the number of members required by the Sub-sinks. However, the mobile sink may not collect the expected amount of data due to interference between transmission and reception on the sub-sinks. The communication resources (including time, bandwidth, etc.) between the sub-sinks and the mobile sink are more precious than those in a network where complete paths between the member nodes and the sub-sinks always exist. Based on this observation, we propose a Mobile Sink First (MSF) scheme to process the communication between the sub-sinks and the mobile sink in order to avoid the interference. In the MSF scheme, the sub-sink will stop receiving the sensed information from its downstream nodes and make use of all time resource and bandwidth resource to transmit data to the mobile sink when it's current sub-sink's turn for transmission. In the meanwhile, the downstream nodes of current sub-sink need to buffer data from their child nodes. After the mobile sink moves away, the downstream nodes will start transmitting buffered data to the current sub sink.

III. Design of Zone-Partitioning in Wireless Sensor Networks

Each member always tries to choose the nearest sub-sink as its destination if the constraints about the MReqs are satisfied, which means all members seldom choose the sub-sink very far away when all nodes are deployed randomly and uniformly. Based on the above observations, we propose an algorithm to build shortest path trees (SPTs) based on zone partitioning without relying on geographical information about the sensors and the sinks. Through zone partitioning, we can divide the whole monitored area into several zones. And then, the MASP scheme is executed separately to get the optimal assignment of the members to the sub-sinks in each zone.

IV. Maximum Amount Shortest Path (MASP)

The total amount of data, Qtotal, collected by the mobile sink in one round consists of the data collected from all sub-sinks as follow

$$\text{Qtotal} = \sum_{i=1}^{ns} \text{Qi}$$

Where, Qi is the amount of data from sub-sink per round. In order to maximize the total amount of data in low density network, it must be guaranteed that no sub-sink owns more members than its MReqs value in Condition i.e. MReqs is the maximum and minimum requirement of members.

Energy calculation is done in the MASP method depending on the amount of data transmitted and received by the nodes in one round.

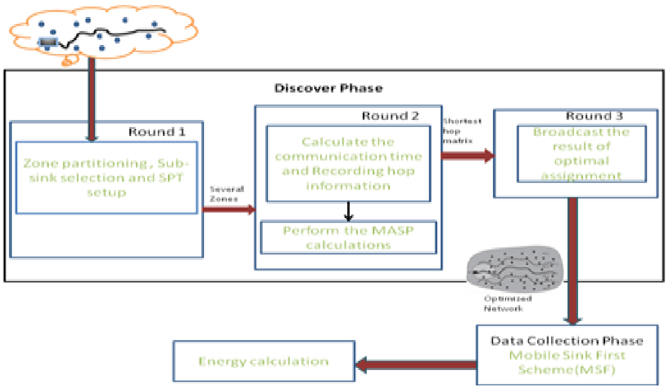

Fig1:MASP implementation

Fig1 shows the different phases in the maximumamount shortest path method and also the optimization of the network

V. Dataflow Diagram

The dataflow diagrams shows the way in which the Maximum Amount Shortest Path (MASP) is implemented In the wireless sensor networks

A. *LEVEL 1*

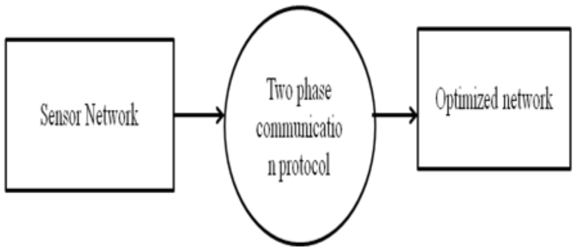

Fig2:wireless sensor networ optimization

B. *LEVEL 2*

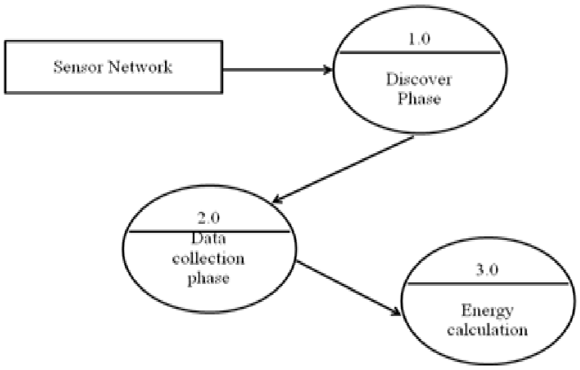

Fig3: MAS Pphases implementation

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

C. LEVEL 3

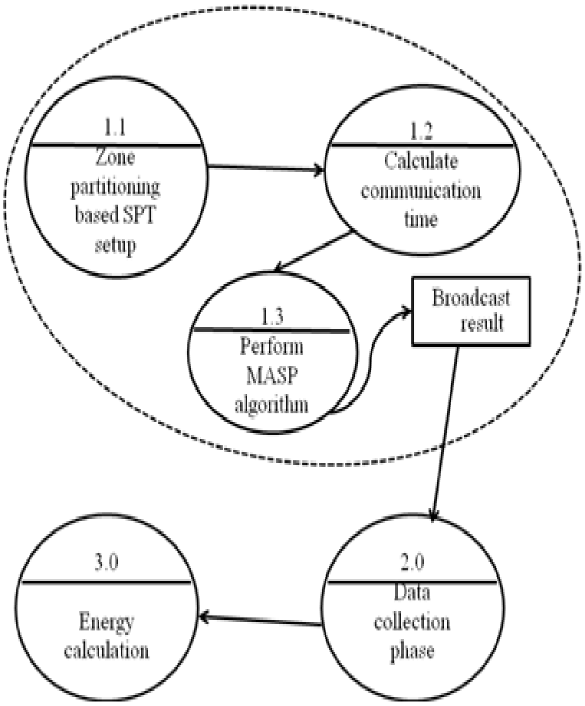

Fig4:detailed implimentation of MASP method

VI. SIMULATION ENVIRONMENT

It is assumed that 50 sensor nodes are arranged in a square area of 300 × 1500m2. Each simulation has been run for 900 seconds of simulation time. The propagation channel of two-ray ground reflection model is assumed with a data rate of 2 Mbps. The environment noise level of -83 or -90 dBm is modeled as a Gaussian random variable with the standard deviation of 1 dB. Noise level of -90 dBm is considered ignorable and interference from other transmitters dominates. On the other hand, noise level of -83 dBm is used to simulate a harsh communication environment.

VII. SIMULATION RESULTS

In this section, we show and analyze the simulation results of network life time, energy consumption, impact of zone partition and total amount of data in network of our system. The following metrics are considered in the simulation results

*Total amount of data is the total amount of information collected by the mobile sink in one round.

*Total energy consumption is the total energy consumed by all sensor nodes in one round.

*network life time is the number of movement rounds of the mobile sink from the beginning of the data collection phase to the first node energy exhaustion

*energy utilization is the ratio between the amount of data and energy consumption.

Fig5 shows the total amount of data collected in MASP and STP methods

Fig6 shows the energy consumption in the MASP and STP methods

Fig7 shows comparison of network life time in two methods

Fig8 shows the impact of zone partition in energy utilization of the MASP and STP methods

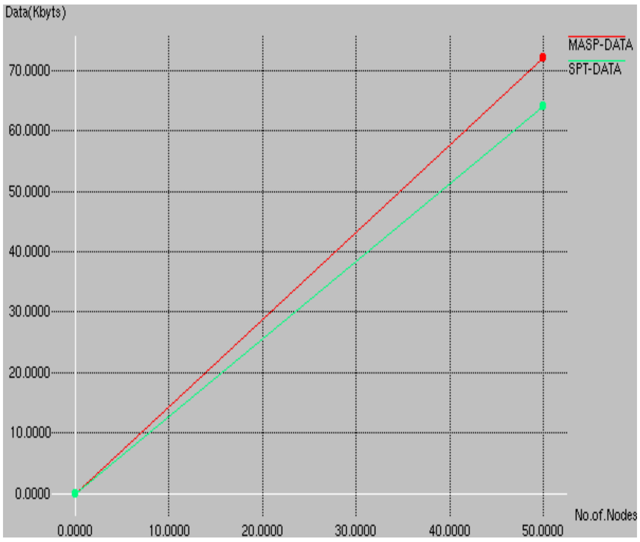

Fig5: comparison of total amount of data collected

The above figure shows that the amount of data collected in the MASP method is more when compared with the STP method

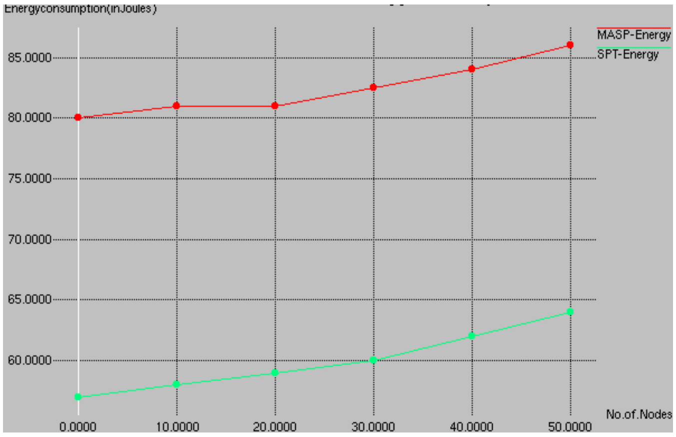

Fig6:energy consumption in the network

Fig6 shows that the MASP as the more energy consumption than the SPT and also the data collection is increased in the networ

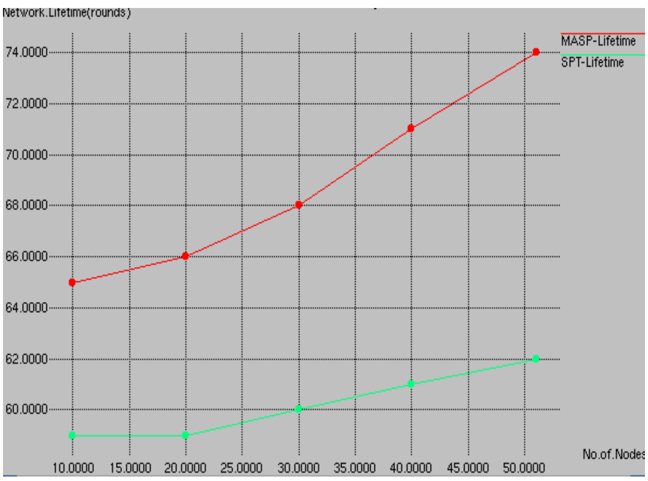

Fig7:comparision of network lifetime

Fig7 shows the increase of network lifetime in MASP due to the consumption of energy

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

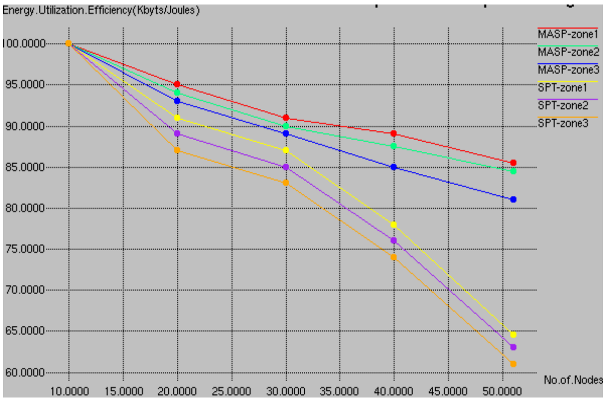

Fig8:impact of zone partition in energy utilization

VIII. CONCLUSION

In this paper, we proposed an efficient data collection scheme called MASP for wireless sensor networks with path constrained mobile sinks. In MASP, the mapping between sensor nodes and sub-sinks is optimized to maximize the amount of data collected by mobile sinks and also balance the energy consumption. Simulation experiments under OMNET++ shows that MASP improves the energy Utilization efficiency and outperforms SPT method in terms of total amount of data and the energy consumption.

This data collection scheme in wireless sensor network as large applications in the environment monitoring of a particular area and can also used in the health monitoring of large buildings

REFERENCES

1. A.chakrabati, A.Sabharwal. and B.Aazhang"communication power optimization in a sensor Network with a Path-Constrained Mobile Observer" ACM Trans. Sensor Networks, vol.2, no.3, pp.297-324, Aug.2006.
2. S.Jain, R.C.Shah, W.Brunette, G.Borriello, and S. Roy, "Exploiting Mobility for Energy Efficient Data Collection in Sensor networks" mobile networks and applications, vol 11,no.3,pp.327-339,2006.
3. .R.C.Shah, S.Roy, S.Jain, and W.Bruneete, "Data MULESs: Modeling a Three- Tier Architecture for sparse Sensor Networks" Proc.First IEEE int,l Workshop o*n sensor Network Protocols and Applications ,pp.30-41,2003.*
4. A.Somasundra,A.Kansal, D.Jea,D.ESTIN, and M.Srivastava, "controllably Mobile Infrastructure for Low energy embedded networks" IEE Trans. Mobile computing, vol.5, no.8,pp.958-973,aug.2006
5. J.Luo,J. Panchard, M.Piorkowski,M .Grosglauser, and J.Hubaux, "MobiRoue:Routing towards a Mobile Sink for improving Lifetime in Sensor Networks" Proc. Second IEEE/ACM int'l Conf.Distributed computing in sensor systems (DCOSS).
6. Al-Karai and A.amal, "Routing Techniques in Wireless Sensor Networks' Survey," IEEE Wireless comm. Magazine vol.11, no.6, pp.6-28, Dec.2004. OMNET++3.3,http://www.omnetpp.org,Oct.2006.
7. M. Marta and M. Cardei, "Using Sink Mobility to Increase Wireless Sensor Networks Lifetime," Proc. Ninth IEEE Int'l Symp.World of Wireless, Mobile and Multimedia Networks (Wow Mom), pp. 1-10, 2008
8. S.Gao, H.Zhang, and S.K. Das, "efficient data collection in wireless sensor networks with path-constrained Mobile sinks,"Proc,10thIEEE ,int'l symp, world of wireless, mobile and multimedia(Wow Mom), 2009.
9. G. Xing, T. Wang, Z. Xie, and W. Jia, "Rendezvous Design Algorithms for Wireless Sensor Networks with a Mobile Base Station," Proc. ACM Mobi Hoc, pp. 231-240, 2008
10. A. Kansal, A. Somasundara, D. Jean, M. Srivastava and D. Estrin, "Intelligent Fluid Infrastructure for Embedded Networks", proc. ACM Mobisys, pp. 111-124, 2004.
11. M. Marta and M. Cardei, "Using Sink Mobility to Increase Wireless Sensor Networks Lifetime," Proc. Ninth IEEE Int'l Symp.World of Wireless, Mobile and Multimedia Networks (WoWMoM), pp. 1-10, 2008

AUTHOR PROFILE

Reddy Bharath Kumar D received B.Tech Degree in Electronics& Communication Engg. From Sree vidyanikethan engineering college, Tirupathi, A.P and know he is pursuing his M.Tech in AITS, Rajampet, A.P. His research interests include Ad Hoc Networks

CH.Nagaraju received B.Tech & M.Tech Degree in Electronics & Communication. He is currently working towards PhD Degree**.** Presently he is with Annamacharya Institute of Technology & Sciences, Rajampet, A.P., India. He is working as Associate Professor in Dept. of ECE. He presented many research papers in National & International Conferences& journals.