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Survey on Time Efficient Data Gathering Approach for Wireless Sensor Network

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***Abstract*—Wireless Sensor Networks is a combination of sensor nodes and base station also known as data collection unit. Sensor nodes in WSN's are thus responsible for performing the basic functions to provide better interaction between network and real time applications. Nodes collect data and forwarded it to sink node. Data transmission can be taken in either static or dynamic nature. In a static network scenario the problem of hotspot which is due to converge-cast can be improved using mobile sink. Using mobile sink delay can be reduced and data can be transmitted within time period in real time applications. In this paper we will discussed various techniques for sink placement and scheduling process with delay constraint. However the sleep-awake scheduling based on duty cycle is proposed in which sleeping time is divided into random sleep time and periodic sleep time.**

***Keywords*—mobile sink, sleep/awake scheduling, periodic sleep time, random sleep time, delay constraint.**

I. Introduction

Wireless Sensor network is having number of sensor nodes which co-operatively send sensed data to the base station. The base station can be referred as sink node. To perform the basic functions such as to assemble data, sensing, sharing of information and processing the information, sink node communicate with the sensor nodes [1]. Sensor nodes collect the information from particular sensing area and transmit it to sink node via multi-hop communication.

Sensor nodes are having limited battery power. Hence an efficient utilization of power is essential for improving network lifetime. Data can be sent from source node to sink node either dynamically or statically. The network can be heterogeneous network or homogeneous network [13]. Depending on the scenario, the necessity of continuous monitoring i.e. information need to send to sink node continuously.

But the problems with this static network specification are coverage holes, sink holes, jamming holes and increased in delay [2]. This is due to sink node must be in active state in order to communicate with the sensor nodes in one hop neighbor of sink node. This problem is known as hotspot problem which is due to converge-cast.

According to recent papers the efficiency of WSNs can be enhance using mobile sink. Delay in data packet transmission can be avoided using mobile sink. Thus by preventing nodes from collision by reducing idle time, minimize end-to-end delay and improves the efficiency of sensor network. The following section presents the related work for data gathering using mobile sink with objective to minimize delay.

The section III presents the detail of proposed method. And the section IV will consider conclusion.

II. Related work

This section specifies the related work for minimizing the delay. The various papers have been written which addresses trade-off between energy and delay. It is necessary to create energy efficient topology with a delay constraint. The factors such as transmission delay, processing delay and the propagation delay related to the distance between sender and receiver affect the wireless sensor network efficiency.

Priya V. Ujawe1 et al. [3] has discussed routing issues in wireless sensor network. The various techniques and algorithm are introduced such as tree based, cluster based, centralized data aggregation, in-network aggregation, ant colony algorithm, shortest path algorithm etc. Based on requirement data aggregation can be done efficiently.

By using carrier technique TDMA (Time Division Multiple Access), the time slots are assigned to user in which each user transmit and receive data within assigned slot [6] [7]. The problem with this techniques is it increases delay as well as improper utilization of channel occur which result in NP-complete problem

In Maximum Amount Shortest path (MASP) [10] data collection by mobile sink is maximized. The mobile sink travels in a fixed trajectory. Nodes which are close to this fixed trajectory are known as sub-sink. If a particular node has to send data packets to mobile sink, it must first transmit it to sub-sink. The sub-sink then transmits data packets to mobile sink directly. The problem associated with this is that long time period is required for finding optimal data path.

Long Cheng et al. [11] introduced Query Based Data Collection Scheme (QBDCS) in which the mobile sink queries for data in sensing field where sensor nodes are deployed uniformly. The node which is nearest to the center of sensing field act as cluster head, the cluster head aggregate data from sensor nodes and is responsible for transmitting packet to mobile sink.

The different trajectories during sink mobility are studied. Yusheng Ji et al. [2] proposed centralized optimal algorithms for DeSM with polynomial complexity are proposed for solving the induced subproblems. The factors which affect the network lifetime are generalized and benefits of sink mobility are shown. But the problem with centralized optimal algorithm is the poor performance of time delay and more energy consumption.

Rangaswamy et al. [13] proposed the set of rules for dynamic route construction and the controlled flooding of sink position is proposed in order to cover large network area and to minimize end-to-end delay, energy utilization, etc. The proposed work is compared using two mobile sink with VGDRA (Virtual Grid based Dynamic Routes Adjustment) technique using single mobile sink [15]. However the proposed method does not guarantee node failure due to movability of sink.

The algorithm for information gathering based on using rendezvous points uses some sensor node as a rendezvous point which is responsible for collecting data from sensor nodes [16]. By using traveling salesman algorithm, the mobile sink co-ordinate with these rendezvous points for data gathering. The mobile sink can be able to transmit data via multi-hop communication but sometimes mobile sink may get fail to identify the data path to reach rendezvous points.

M. Sudha et al. [17] presented scheme Energy Efficient Shortest Path (EESP) is used with Multiple Mobile Sink (MMS) also known as Rouse-Slumber which minimizes the energy utilization with delay constraint. The RS scheduling algorithm works well with dynamic trajectory used in wireless sensor network via multi-hop data transmission. Data collection by mobile sink with the help of sub-link, to minimize the delay may get fail due to improper co-ordination.

Due to problem of extra delays during transmission of data packet from source node to destination node the author suggest using anycast data forwarding with sleep wake scheduling. Here the transmitting node [19] [15] does not require the time interval to wake up by its next hop relay node which thus reduced end-to-end delay. The redundancy of data can be increased using the anycast data forwarding which affect the data aggregation.

By using heuristic method [23] the energy consumption of sensor nodes can be minimize. To avoid delay bound, B. Zhao et al. proposed WRP (weighted rendezvous planning) in which each sensor node is having particular weight based on the number of data packets transmitted by nodes and hop distance from that data path. Using this method the NP-hard problem can be resolved by optimizing shortest path for forwarding data but increases complexity.

As shown in table 1, the various techniques are discussed for data transfer in wireless sensor network. Different scheduling scheme are proposed for transferring data. But the problems with given techniques are improper energy consumption management and increased in end-to-end delay. Also the overhead of scheduling is increased in centralized scheduling technique and does not support large size network hence these techniques are not reliable. The summary of related work is given below with techniques along its advantages and disadvantages.

Table 1: Comparison of different data gathering techniques

Sr. No.	Technique used	Advantages	Disadvantages
1.	Extended SSDR Algorithm for DeSM (E-SSDR) [2]	Minimize delay bound and improve scheduling process for routing.	Centralized optimal algorithm developed but not worked for distributed networks.
2.	TDMA (Time Division Multiple Access) [7]	Each user get an equal opportunity to transmit and receive data	Improper utilization of channel and the problem of NP-Complete occur.
3.	Maximum Amount Shortest Path (MASP) [10]	Minimize end-to end delay.	Its takes long time to find the optimal path for routing.
4.	Query Based Data Collection Scheme (QBDCS) [11]	Minimize the latency.	Not feasible for large scale network.
5.	Cluster based approach using multiple mobile sink [13]	Network lifetime can be increased with optimal routes.	Node or sink failure due to interferences.
6.	Rendezvous points based data gathering [16]	Sharing network load balance between different nodes.	Mobile sink node only visits rendezvous points.
7.	Rouse-Slumber Scheduling [17]	Reduce energy consumption.	Synchronization in scheduling process becomes complex.

III. PROPOSED WORK

As shown in figure 1, sleep/awake scheduling can be used in which the sensor nodes include different phases for data transmission, reception, idle phase and sleep state based on duty cycle approach.

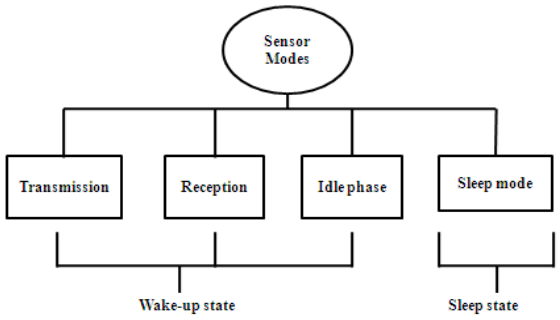

Figure 1: sleep-awake scheduling

After establishing network scenario the sensor nodes are assemble according to energy level of each sensor node. In second phase probability of entering in sleep state of sensor nodes in every level is established. The modes of node i.e. either sleep mode or active mode is decided by estimating the probability through distributive density of nodes. The total time period is divided into random sleep time and periodic sleep time. In random sleep time the sleep and awake status is not fixed whereas in periodic sleep time the sleep and awake status is fixed in every duty cycle. In this way the sleep time and active time can be adjustable. Hence the maximum energy power of sensor nodes can be saved during the transmission phase and better quality of service can be obtained.

The proposed system is to minimize the scheduling overhead in centralized as well as in distributed scheduling with large

size networks. For that purpose two mobility based techniques such as controlled mobility and random mobility are used. Whereas sinks are moved randomly in random mobility and in controlled mobility sinks are moved deterministically across the network.

The system also supports multiple mobile sink based scheduling with limited energy consumption. The scheduling scheme is based on multiple mobile sink mobility with delay and energy parameters to support large scale network. Using this scheduling process with multiple mobile sink the parameters are integrated in order to schedule nodes with greater scalability.

As shown in below figure 2, the scheduling process is to schedule the data movement path by mobile sink. Based on movement of mobile sink, data path is estimated and time periods are assigned to nodes in scheduling scheme. Classification of system is specified into five modules as given below.

In network circumference analysis the properties of sink and node are collected from user. The placement of node and covering area is taken into consideration as well as the information of coverage area and nodes are analyzed. The energy level of sink and nodes are analyzed in this.

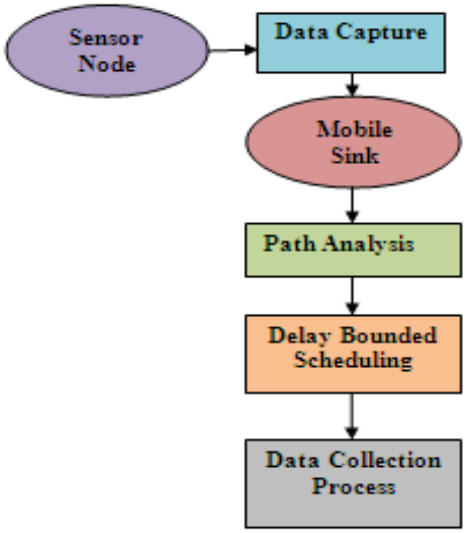

Figure 2: Mobile-Sink based scheduling in WSN

Monitoring of data and data gathering are done in data capture phase. Using local storages the collected data are updated with time interval and these updated data is forwarded to mobile sink. To perform scheduling for single sink centralized scheduling process is follow. Data transmission of sensor nodes and mobile sink are used for this process. Information related to delay in data transmission packets are needed to update data process. For multiple sink there is distributed scheduling process in which requests for data are submitted by users. These requests are then processed or handle by mobile sink.

Movement plan for sink is processed with the help of region based sink movement model which is based on details of sink coverage and network design. Sensor nodes are responsible for transferring data packets to mobile sink. In data collection process the user request for data. These query requests are then evaluated by mobile sink and by processing query request data packet is transmitted by it to intended user.

IV. Conclusion

In this paper we focus on various techniques for efficient data gathering with limited energy consumption. We studied different scheduling schemes whereas as emphasis is given on delay minimization. But the problems inherent with previous work are local minimum problem and mobile sink information cannot flood efficiently when mobile the mobile sink moves its position. Using the proposed technique it is possible to reduce the overhead of data and it is feasible for multipath data transmission. The problems can be solved efficiently with a delay constraint and minimize the end to-end delay. It can also improve other parameters such as power efficiency per packet, general delay, packet delivery ratio and maximize network lifetime.

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