Review on Sink Mobility Approaches in Wireless Sensor Network (WSN)

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***Abstract*— The wireless sensor networks are specially deployed in human inaccessible areas to monitor the environmental conditions. The nodes must work for longer duration of time possible. For this the nodes are usually clustered in the groups and they forward the data to the sink node via their cluster heads. Another approach used in combination with the clustering is the mobility of the sink node where the sink node moves to different locations in network to collect data. This paper presents a survey about the approaches that uses mobile sink for data collection.**

***Keywords*— Wireless sensor network, cluster heads, sink node**

I. INTRODUCTION

Wireless is a basic and comprehensive term which describes the telecommunication where electro-magnetic waves transfer the signal over some part or entire communication path. Wireless technology is capable of reaching virtually to every location on the earth. Wireless Sensor Network consists of two components in its infrastructure: sensor nodes and sink nodes. Sink nodes are regarded as base stations in the network that receive and collect data wirelessly and provide it to its clients.

In a wireless sensor network, sensors are dispersed in the field and communicate with each other wirelessly. However, sensor nodes work on battery with limited supply of energy. Furthermore, computational power of a sensor is also weaker as compared to the sink nodes. A sensor node uses energy from the battery and when a sensor node runs short of the energy, it stops granting any services such as sensing, data processing or data communication. When this happens, sensor is declared as "dead" and hence removed from the network topology. The lifetime of a sensor network is defined as the time interval from its deployment to the time a "critical" number of sensor nodes die, making the network unusable.Therefore, the lifetime of a sensor node depends greatly on the battery power. A small section of "dead" sensor nodes can directly affect the entire lifetime of the network and thus lead to a great loss in the network because of routing path's reallocation and stoppage of sensing and reporting the events in the environment. Therefore, in order to extend the lifetime of the network and guarantee the robustness of the sensor network, efficient energy consumption and energy conservation are of great significance in wireless sensor networks while designing and deploying networks for practical purposes.

TABLE I

Technique	Operation	Focuses on
MSRP [1]	Removes the hotspot problem by moving the sink to the high energy cluster head nodes to collect the data from them.	Improving throughput and lifetime of the network.
Linear Programming based Controlled Sink Mobility [2]	LP determines the time a sink stays at a particular location, data transfer rate between the nodes and the quantity of buffered packets. Nodes send their data to the sink via multi-hop path of reduced length and all nodes maintain a buffer in which they store their data before sink comes closer to them.	Improving network lifetime and reduces delay.
Multiple Mobile sinks based approach [3]	Next position of the sink is determined by using biased random walk method. Optimal data transmission path is found using rendezvous point selection with splitting tree technique.	Improving energy efficiency and delay.
LEACH – C based approach [6]	Mobile sink moves to the cluster heads according to the schedule made using traveling salesman problem.	Improving network lifetime.
Distributed energy efficient clustering algorithm [9]	The sink moves around the target area (along circumference of the network) with a fixed path and speed.CH transmit its data packet to the sink when distance between them is minimal	Reducing energy consumption in the network.

II. LITERATURE REVIEW

In [1], authors discussed about the hotspot problem and proposed a Mobile Sink based Routing Protocol (MSRP) for Prolonging Network Lifetime in Clustered Wireless Sensor Networks. In MSRP, mobile sink moves in the clustered WSN to gather sensed data from the CHs inside its region. Mobile sink has to maintain the information data about the residual energy of the CHs while gathering the data. Mobile sink, considering the residual energy of CHs move to the CHs

having higher energy. Therefore, the hotspot problem is minimized as the next neighbor of the sink is high energy node and it changes as a result of regular sink movement. This protocol is effective in the efficient utilization of WSN energy and enhances the network life time. In [2] authors propose a new strategy in which nodes send their data to the sink via multi-hop path of reduced length and all nodes maintain a buffer in which they store their data before sink comes closer to them. This exempts the different sensors to relay the data. This strategy is effective in saving the energy along with a check that no data has been lost due to buffer overflow. WSN lifetime is optimized through controlled sink mobility and limited buffer capacity using Linear Program (LP). LP determines the time a sink stays at a particular location, data transfer rate between the nodes and the quantity of buffered packets. The proposed solution claims to achieve better lifetime, generate and transmit more data to the mobile sink and more load balancing among the nodes. In [3] authors proposed an efficient routing protocol for single mobile sink and multiple mobile sinks for gathering of the data in WSNs. In this scheme, the next position of the sink is determined by using biased random walk method. After this the optimal data transmission path is found using rendezvous point selection with splitting tree technique. If the sink moves within the range of the rendezvous point, it receives the gathered data and if it moves out of the range, it chooses a relay node from its neighbors to pass the packets from meeting point to the sink. The scheme suggested here is effective in reducing the signal overhead and improving the triangular routing problem. The proposed model effectively supports sink mobility with low overhead and delay when compared with Intelligent Agent-based Routing protocol (IAR) and also increases the reliability and delivery ratio when the number of sources increases.

In [4], authors propose a novel clustering scheme EECS for wireless sensor networks, which are suitable for data gathering applications at regular intervals. In this approach cluster heads are elected among the nodes having more residual energy through local radio communication by having well cluster head distribution. This novel method is used to balance the load between the cluster heads and proves that EECS surpass LEACH significantly with increasing the network lifetime over 35%.

In [5], authors propose a novel network construction and routing method by defining three different duties for sensor nodes i.e. node gateways, cluster heads and cluster members and then by applying a hierarchical structure from sink to the normal sensor nodes. The proposed method provides an efficient rationale to support the maximum coverage to recover the missing data with node mobility and to reduce the energy wastage. In this way the lifetime of the network improves significantly.

In [6], author uses optimum approach i.e. Leach-C to increase the lifetime of a wireless sensor networks. In this approach, cluster heads are distributed all over the network for better performance. Sink collects the data from each cluster heads by finding the optimum path with the help of travelling salesman problem. Here energy consumption is reduced by using Leach-C and travelling sales problem. Mobile sink gathers data, hence, reducing the energy consumption and so extends the network lifetime.

This paper [7] discusses the controlled sink mobility in clustered sensor networks where all cluster heads send buffered data to the sink in a specified period of time called data reporting time (drt). In the proposed scheme, cluster heads data is collected by sink in drt time span, thus, maximizing the lifetime of the network with the help of MILP (Mixed Integer Linear Programming) model. The scheme is then compared with the other related schemes by using other means of simulation scenarios.

In [8], mobile sink collects the data from all sensor nodes and transmit it through the network. The distance between transmitter and receiver is calculated before available transmission and then lowest transmission power is calculated and determined. Lowest transmission power is used to transmit the measurement data. During normal operating condition, sensor nodes are set to sleep/wake up mode for saving the energy.

In the energy- constrained wireless sensor networks (WSNs), the clustering algorithms for WSNs with a static sink frequently suffers from uneven energy consumption problems, where cluster heads (CHs) further away from sink consume more energy in a single hop communication, with the CHs sending its data directly to the sink. In order to solve such problem, the authors in [9] have proposed a Distributed Energy-efficient Clustering Algorithm for mobile-sink based WSNs, where the sink moves around the target area with a fixed path and speed. The proposed clustering algorithm, binds each sensor node with a CH via single or multi-hop communication, where a CH transmit its data packet to the sink when distance between them is minimal. Thus, the controlled movement of the sink around the network helps in balancing the energy consumption of the sensor networks. The experimental results demonstrate the efficiency of their proposed algorithm over the existing state-of-the-art algorithms in terms of different metrics like, network lifetime, energy consumption, etc

III. CONCLUSION

This paper presents the previous studies focused on improving the lifespan of the wireless sensor networks by using mobile sink nodes. While some of the techniques would focus on the controlled mobility of the mobile sink to collect the data from the nodes in the network, the other schemes would allow the sink nodes to move randomly. In Distributed Energy-efficient Clustering Algorithm the sink node moves at outer circumference of the circular network, in future this scheme would be modified by changing the sink mobility pattern to increase the performance of the network.

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