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Loading Balanced Clusters and Double Data Uploading in Wireless Sensor Networks

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***Abstract*: A framework with three layers is proposed for data collection in wireless sensor networks, which consists of the sensor layer, cluster head layer, and SenCar layer. The aim is to achieve good scalability, long network lifetime and low data collection latency. In the sensor layer, a distributed load balanced clustering (LBC) algorithm is projected for sensors to self-organize themselves into clusters. To compare with existing clustering methods, this scheme generates multiple cluster heads in every cluster to balance the work load and facilitate dual data uploading. At the cluster head layer, the inter-cluster transmission range is carefully chosen to guarantee the connectivity among the clusters. Multiple cluster heads within a cluster cooperate with each other to perform energy-saving inter-cluster communications. Through inter-cluster transmissions, cluster head information is forwarded to SenCar for its moving trajectory planning. At the mobile collector layer, SenCar is equipped with two antennas, which enables two cluster heads to concurrently upload data to SenCar in each time by utilizing multi-user multiple-input and multiple-output practice. The trajectory planning for SenCar is optimized to fully utilize dual data uploading capability by properly selecting polling points in each cluster. By visiting each selected polling point, SenCar can efficiently gather data from cluster heads and transport the data to the static data sink. Usually simulations are conducted to assess the efficiency of the proposed domain.**

***Index Terms* — Cluster heads, Layers, SenCar, Sensors.**

I. INTRODUCTION

Wireless Sensor Networks (WSNs) is an outstanding data collection paradigm for extracting local measures of interests. In such applications, sensors are generally densely deployed and randomly scattered over a sensing field and left unattended after being deployed, which make it difficult to boost or replace their batteries. A Wireless Sensor Network (WSN) typically consists of a sink node sometimes referred to as a Base Station and a number of small wireless sensor nodes. The base station is assumed to be secure with unlimited available energy while the sensor nodes are assumed to be unsecured with limited available energy. After sensors form into autonomous organizations, those sensors near the data sink typically exhaust their batteries much faster than others due to more relaying traffic. When sensors around the data sink exhaust their energy, network connectivity and coverage may not be guaranteed. Due to these constraints, it is crucial to design an energy-efficient data collection scheme that consumes energy uniformly across the sensing field to achieve long network lifetime. It provide effective solutions to data collection in WSNs, their inefficiencies have been noticed. Specifically, in relay routing schemes, minimizing energy consumption on the forwarding path does not necessarily prolong network lifetime, since some critical sensors on the path may run out of energy faster than others. The emerging field of wireless sensor networks combines sensing, computation, and communication into a single tiny device. While the capabilities of any single device are minimal, the composition of hundreds of devices offers radical new technological possibilities. The power of wireless sensor networks lies in the ability to deploy large numbers of tiny nodes that assemble and configure themselves. Usage scenarios for these devices range from real-time tracking, to monitoring of environmental conditions, to ubiquitous computing environments, to monitor the health of structures or equipment. While often referred to as wireless sensor networks, they can also control actuators that extend control from cyberspace into the physical world. Clustering is an efficient technique to improve scalability and life time of a wireless sensor network. In dual data uploading process the concurrent effort is used to upload the data. This mechanism is used to overcome the latency delay when the output is

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under progression. These data are used to work under the mechanism of dual antenna.

II. DATA GATHERING S

Here data were gathered by using three layers, such as Sensor layer, Cluster head layer and SenCar layer. Upon that sensor layer is the top most layer. Every sensor is assumed to be able to communicate only with its neighbors, i.e., the nodes within its transmission range. Through initialization, sensors are self-organized into clusters. Every sensor decides to be either a cluster head or a cluster member in a scattered manner. For ease, the numerous cluster heads within a cluster are said to be cluster head groups, with each cluster head being the peers of others. The algorithm constructs clusters such that each sensor in a cluster is one hop away from at least one cluster head. Herewith, every sensor nodes frankly communicate with the sink or basically forwards the data packets to the neighboring nodes and finally reach to the sink. On the existing system it is limited with delay, node failure, data redundancy and large amount of energy utilization, since it is using flooding, gossiping, direct communication, etc., to communicate between the nodes, thus mere to negative perspective of using the existing methodology. During the arrival of Sensor layer, the sensors were grouped into clusters on the cluster head layer. Now CHG took place on every cluster and uploads buffered data via MU-MIMO communications and synchronizes its local clocks with the global clock on SenCar via acknowledgement messages. Finally, periodical reclustering is performed to rotate cluster heads among sensors with higher residual energy to avoid draining energy from cluster heads. Such information must be sent before SenCar departs for its data collection tour. Upon receiving this information, SenCar utilizes it to determine where to stop within each cluster to collect data from its CHG. To collect data as fast as possible, SenCar should stop at positions inside a cluster that can achieve maximum capacity [7][8]. In theory, since SenCar is mobile, it has the freedom to select any preferred position.

A. *Data Synchronization*

The notion of applying Multi User - Multi Input and Multi Output are rapidly used for data collection timings and reducing the overall latency. Multi-user MIMO can leverage multiple users as spatially distributed transmission resources, at the cost of somewhat more expensive signal processing. In comparison, conventional, or single-user MIMO considers only local device multiple antenna dimensions. Multi-user MIMO algorithms are developed to enhance MIMO systems when the number of users or connections is greater than one. Multi-user MIMO can be generalized into two categories: MIMO broadcast channels and MIMO multiple access channels for downlink and uplink situations, respectively. Single-user MIMO can be represented as point-to-point, pair wise MIMO. A mobile collector equipped with multiple antennas overcomes these difficulties by reducing data collection latency and reaching hazard regions not accessible by human being [1][2][10].

III. LOAD BALANCED CLUSTERING

The crucial operation of clustering is the selection of cluster heads. To prolong network lifetime, we naturally expect the selected cluster heads are the ones with higher residual energy. Hence, we use the percentage of residual energy of every sensor as the initial clustering priority. Assume that a set of sensors, are homogeneous and each of them independently makes the decision on its status based on local information. After running the LBC algorithm, each cluster will have at most M cluster heads, which means that the size of CHG of each cluster is no more than M. Each sensor is covered by at least one cluster head inside a cluster. The LBC algorithm is comprised of four phases: (1) Initialization (2) Status claim (3) Cluster forming and (4) Cluster head synchronization.

A. *Initialization Phase*

In the initialization phase, each sensor acquaints itself with all the neighbors in its proximity. If a sensor is an isolated node (i.e., no neighbor exists), it claims itself to be a cluster head and the cluster only contains itself. Otherwise, a sensor, say, si, first sets its status as “tentative” and its initial priority by the percentage of residual energy.

B. *Status Claim*

In the second phase, each sensor determines its status by iteratively updating its local information, refraining from promptly claiming to be a cluster head. We use the node degree to control the maximum number of iterations for each sensor. Whether a sensor can finally become a cluster head primarily depends on its priority.

C. *Cluster Forming*

The third phase is cluster forming that decides which cluster head a sensor should be associated with. The criteria can be described as follows: for a sensor with tentative status or being a cluster member, it would randomly affiliate itself

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with a cluster head among its candidate peers for load balance purpose. Cluster members that receive this message switch to the initialization phase to perform a new round of clustering.

D. *Synchronization among Cluster Heads*

To perform data collection by TDMA techniques, intra cluster time synchronization among established cluster heads should be considered. The fourth phase is to synchronize local clocks among cluster heads in a CHG by beacon messages. First, each cluster head will send out a beacon message with its initial priority and local clock information to other nodes in the CHG. Then it examines the received beacon messages to see if the priority of a beacon message is higher. If yes, it adjusts its local clock according to the timestamp of the beacon message. In our framework, such synchronization among cluster heads is only performed while SenCar is collecting data.

IV. CONNECTION AMONG CHGS

Multiple cluster heads in a CHG coordinate among cluster members and collaborate to communicate with other CHGs. The inter-cluster organization is determined by the relationship between the inter-cluster transmission range Rt and the sensor transmission range Rs. Clearly, Rt is much larger than Rs. It implies that in a traditional single head cluster, each cluster head must greatly enhance its output power to reach other cluster heads. However, in LBC-DDU the multiple cluster heads of a CHG can mitigate this rigid demand since they can cooperate for inter-cluster transmission and relax the requirement on the individual output power.

A. *Data Uploading*

Considering the selections of the schedule pattern and selected polling points for the corresponding scheduling pairs, aiming at achieving the maximum sum of MIMO uplink capacity in a cluster. We assume that SenCar utilizes the minimum mean square error receiver with successive interference cancellation (MMSE-SIC) as the receiving structure for each MIMO data uploading. Once the selected polling points for each cluster are chosen, SenCar can finally determine its trajectory. Since SenCar departs from the data sink and also needs to return the collected data to it, the trajectory of SenCar is a route that visits each selected polling point once. This is the well-known travelling salesman problem (TSP). Since SenCar has the knowledge about the locations of polling points, it can utilize an approximate or heuristic algorithm for the TSP problem to find the shortest moving trajectory among selected polling points, e.g., the nearest neighbor algorithm [10][11].

V. ASSESSING THE METHODOLOGY

The assessment of the framework and compare it with other schemes. Since the main focus of this work is to explore different choices of data collection schemes, for fair comparison, all the schemes are implemented under the same duty-cycling MAC strategy. The first scheme for comparison is to relay messages to a static data sink in multi-hops and we call it Relay Routing. In this way, the relay routing method can provide load balance among nodes along the routing path. The second scheme to compare is based on Collection Tree Protocol [6]. We observe that more energy is consumed with the Collection Tree method especially on nodes near the data sink represented by the bright spots. The result achieved on this work was extremely better than the existing system. Few results are noticed to show the better performances on this methodology. The following Figures from 1.1 to 1.4 represent the double data uploading methodology.

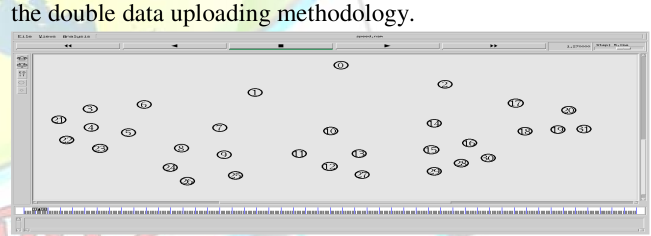

Figure 1.1 Node creation

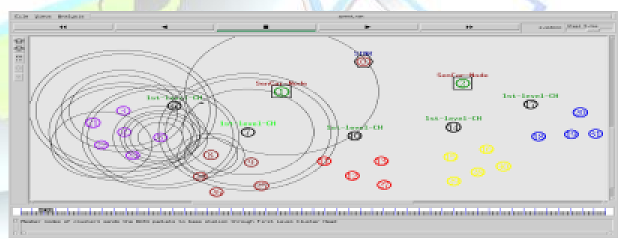

Figure 1.2 Cluster formation

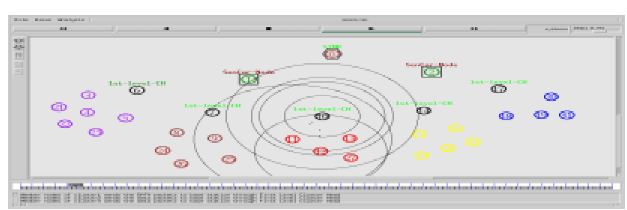

Figure 1.3 Inner Cluster Transmit Data to the Cluster

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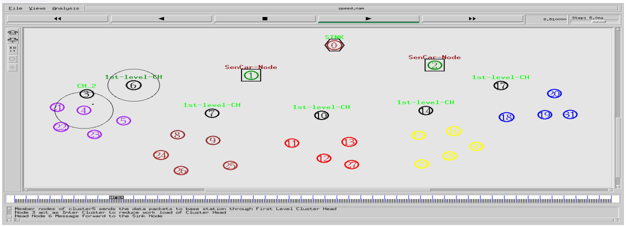

FIGURE 1.4 CLUSTER HEAD TRANSMIT DATA TO THE SENCAR NODE

VI. CONCLUSION

This study achieves the dual data uploading process for mobile data collection in a WSN. The framework consists of sensor layer, cluster head layer and SenCar layer. This employs distributed load balanced clustering for sensor self-organization, adopts collaborative inter-cluster communication for energy-efficient transmissions among CHGs, uses dual data uploading for fast data collection, and optimizes SenCars mobility to fully enjoy the benefits of MU-MIMO. The performance study demonstrates the effectiveness of the proposed framework.

VII. FUTURE ENHANCEMENTS

In future we are planning to study few problems which related to our work. The problems were identified on the base of polling point's findings and the grouping clusters. A well developed methodology will be schedules to the separation the continuous space to locate the optimal polling point for each cluster. Next we find the compatible pairs to achieve the overall ranges. Different algorithms will be assessed to become accustomed to the proposed methodology for Multi User Multi input Multi output notion.

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