Intelligent Load Balance Clustering in Wireless Sensor Networks

Saranya.D.
PG Student, Sri Sairam Engineering College, Chennai

Susilasakthy.S.
Assistant Professor, Department of IT, Sri Sairam Engineering College, Chennai

Abstract— Energy consumption becomes a primary concern in a Wireless Sensor Network. In this paper, we study the tradeoff between energy saving and data gathering latency in mobile data gathering by exploring a local data aggregation and the moving length of the SensorCar .It has different layer frameworks for mobile data collection in wireless sensor networks, which includes the load balanced clustering, cluster head selection, and data collection (called SenCar) layer. The framework employs distributed balanced clustering and dual uploading of data. Emergency signal priority not assigned in LBC-DDU. The Priority Based Multi SenCar technique is introduce in WSNs to overcome these issues.

Keywords— Mobile data gathering, Sencar, Emergency signal priority.

I. INTRODUCTION

Wireless sensor network is a interface between the virtual and physical worlds. It is one of the rapidly developing new technology, the applications such as industrial process control, security and surveillance, environmental sensing, and structural health monitoring. The challenges of energy efficiency, robustness, and autonomy are addressed in these systems. The energy consumption becomes crucial for the network to functionally operate for an expected period of time. The factors such as connectivity, energy usage and interference must be carefully balance in WSNs. Therefore, the data collection scheme should have a good scalability, long network life time, and low data collection latencylatency. For the efficient data collection we must focus on enhanced relay routing, organizes sensors into clusters for data forwarding, and use of mobile collectors to reduce the burden of routing.

In wireless sensor network each node consists of components such as sensors, memory to store the sensed data, the processor to handle the data, GPS to trace the location, radio transceiver to transmit and receive the datas, and the power source which is used for the functioning of all these components.

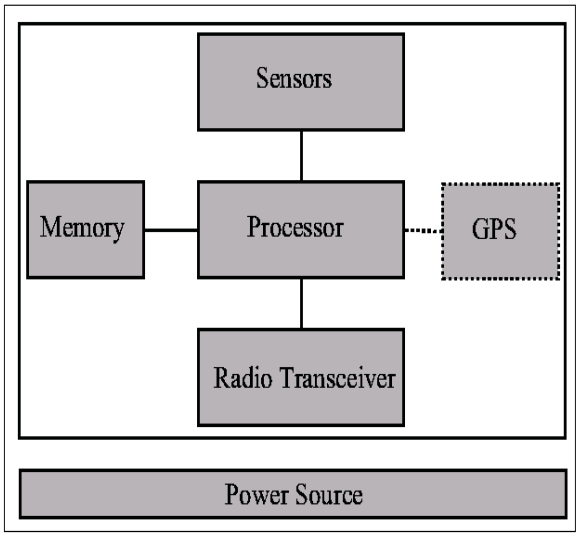

Figure 1. Basic components of a WSN node.

II. RELAY ROUTING AND CLUSTERING

In wireless sensor networks the routing can be made efficient by types of local state information such as link quality, link distance, residual energy, position information. There are several approaches to improve routing robust routing, energy efficient routing and geographic routing, etc. The effective method to route messages to the data sink by relay routing which occurs in multihop transmission. Increasing the number of message relaying leads to decreases the energy of the sensor nodes.

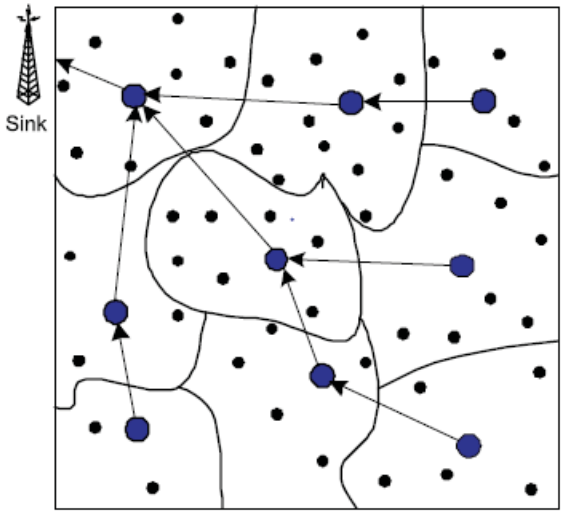

Figure 2. Example of Sensor clustering

Clustering is the another approach for reducing the number of relays. The cluster formation results in the minimum number of clusters, from this the high residual energy node becomes cluster head and that takes responsibility for data forwarding this protocol has named as LEACH (Low Energy Adaptive Clustering Hierarchy). LEACH is the most popular for clustering and routing in wireless sensor networks. Another approach for clustering is HEED and it is based on link quality. Here, we using multi head clustering method to compatible with Multi-user Multiple-Input and Multiple-Output technique.

III. DATA COLLECTION AND MU-MIMO IN WSNs

Mobility for data collection benefits in balancing energy consumption in both connecting and disconnected region in the network. The mobile collector is called as SenCar it gather the data from sensors through single-hop transmission. For mobile data collection , we exploiting Multi-user Multiple-Input and Multiple-Output technique to reduce data transmission time.

The MIMO improves energy consumption in the circuits. In Single-Input-Single-Output approach it only used for minimum transmission distances. Data uploading using MU-MIMO have reduce data collection latency.

IV. SENSOR CLUSTERING

In this each sensors are have information about its neighbor node and able to communicate each other. This has various steps to form a cluster, which beings with initialization it made the sensors to self organized into cluster then decides about the cluster heads (CH) and cluster members. Finally the nodes with higher residual energy has becomes cluster heads. More number of cluster is known as cluster head group (CHG). If a sensor is isolated it claims itself to be a cluster head this status is assumes has tentative. The next steps to defines the status of the sensors in the networks, it can be determine by each sensors to uploading its local information to its neighbor node. To control the iteration we use the node degree of each sensors that is threshold value of cluster heads and cluster members. By comparing these threshold values with their neighbors the sensors decides to either it quit from the iteration or not. The current candidate peers announce to be a cluster head by broadcasting the data packet with ID. The sensor neighborhood receives the packet and it have to be update its status to cluster head here, updating the candidate peers of each sensor.

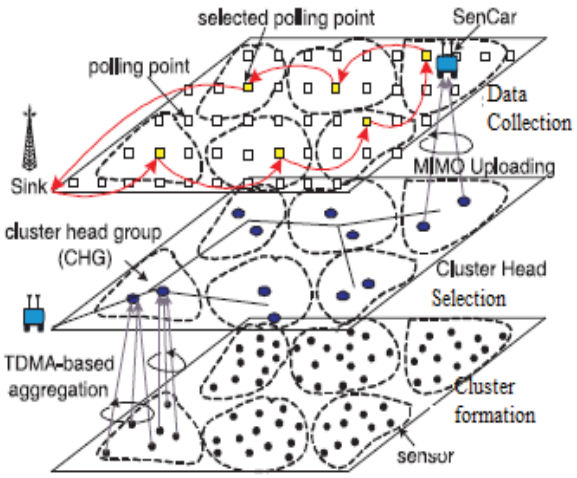

Figure 3. Overview of balanced clustering and dual uploading of data

Cluster forming is another step, it defines which cluster head a sensor should be associated with. For sensor with tentative or a member, it randomly affiliate with a cluster head to balance the clusters. In few cases, there is no cluster head among the candidate peers with tentative status it claims its current candidate peers as the cluster heads. Each cluster has two cluster heads and sensors are affiliated with in the two cluster heads. If CHs running in low battery it needs to perform re-clustering and begins from initialization to get new round of clustering.

The data collection can be perform by TDMA techniques it establishes the intra-cluster time synchronization among every cluster heads. In cluster head groups, synchronize the local clocks among the cluster heads by use of beacon messages. To check the priority of beacon messages examines the received message whether it has higher priority. If the priority is high, according to timestamp it adjust the local clock. Synchronization only perform while sencar collecting the data to manage the message overhead within a cluster.

V. CLUSTER HEAD SELECTION

Cluster head selection is the next layer as before mentioned more number of cluster heads in group coordinate among cluster members and communicate with each other cluster head groups(CHGs). The inter cluster communication is essential among the CHGs. This inter cluster transmissionis used to forward the data packets and information of each CHGs to SenCar. This information will be used for choose the best moving path of the SenCar.

The connectivity among the cluster heads is the major issue at inter-cluster organization. It can be determine by the relationship between the inter- cluster and sensors transmission range. The transmission range of inter-cluster is larger than the transmission range of sensor, it enhance the output power. The inter-cluster communication is a energy efficient method which collaborate the CHGs. For MIMO technique construct multiple antennas on both the transmitter and receiver side. Each cluster heads as the transmitter encoders, to achieve spatial diversity the space-time block code is used. The MIMO consumes less transmissions energy and reliable than the single-input single-output technique. The less energy consumes in inter-cluster transmission by multiple head structure.

VI. ROUTING PLANNING

With cluster head group information t he data collection tour have focus on best path for SenCar. In each cluster the SenCar would stop at some selected location to collect data from cluster heads in single-hop transmission this location is known as polling points. Once it finds the correct and best route then it reduces the selecting of polling points and perform sequence visit to that cluster.

Some of the Properties for Polling Points

The SenCar is consists of two antennas, each cluster has only one antenna. The multiple antennas in SenCar acts as receiver in data uploading. To avoid mixed data stream while transmitting distinct data simultaneously, the SenCar equipped with atmost two antennas at receiver side. This concurrent data transmission reduces the uploading time .

There are number of choice to schedule the cluster heads pairs this type of pairing is called scheduling pair. This scheduling pair collects data from cluster heads. For the fast data collection it should be

- In scheduling pair the cluster heads should be covered by SenCar with the same transmission range.
- SenCar need to achieve the maximum sum of uplink MIMO capacities in the cluster

The SenCar has the knowledge of the IDs of sensor, the information can be collected prior to each data collection. These information contains the IDs of cluster heads and possible schedule of SenCar. It choose the scheduling pair which cover two cluster heads simultaneously.

6.1 MU-MIMO UPLOADING

The data uploading can be obtain by Multi-User Multiple-Input and Multiple-Output (MU – MIMO) technique. In this sum of maximum MIMO uplink capacity have to be achieve in a cluster. For every data uploading using MIMO it has minimum error and interference cancellation receiver. This receiver first decodes the information of first cluster head and treats another one as interference and then it cancels the signal part from received signals.

The SenCar determines its final routing by selecting the polling points in each cluster. In each selected polling points it as proper visiting sequence which reduces the moving time on the routing. The SenCar know the location of polling points and to find shortest path it use the traveling salesman problem.

6.2 DATA COLLECTION

The data message has to reach the destination within the specified deadline , if the deadline expires it will degrade the performance of the network. To overcome this in mobile data collection earliest first deadline algorithm is used, in this the SenCar first visit earliest deadline messages.

The cluster send the deadline information to SenCar by collecting the data and calculate its deadline from messages in the cluster. Then the SenCar select the earliest deadline and move towards to collect data through MU-M IMO transmission. The SenCar after completes the data gathering it checks about the violations from next polling points, then immediately upload data to data sink and the data collection resumes in the same way.

VII. PERFORMANCE EVALUATION

We could evaluate by comparing other schemes with our framework performance. Our framework provide load balance routing path among nodes in the relay routing. The other scheme is collection tree protocol, here the routing metric is expected number of transmission and route with lower expected number of transmissions. To enhance the communication the clustered MIMO allows MIMO communication among cluster heads. The mobile MIMO that selects multiple cluster heads to enable the multiuser data uploading to SenCar in each cluster.

The mobile data collection works for both connected and disconnected networks, it acts as virtual links to connect the subnetworks. The less energy consumption on sensor nodes in mobile MIMO, that lower energy consumption would longer network lifetime is shown in the graph (figure 4).

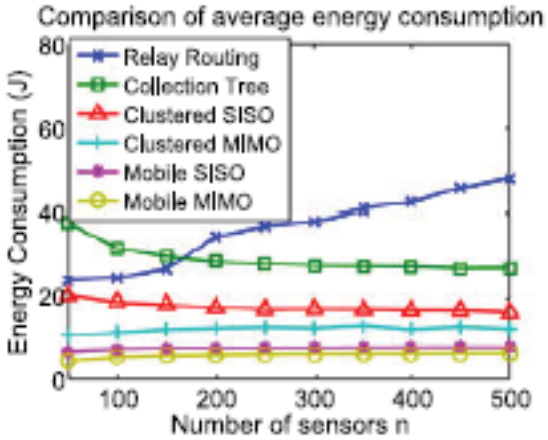

Figure 4. Comparison of average energy consumption

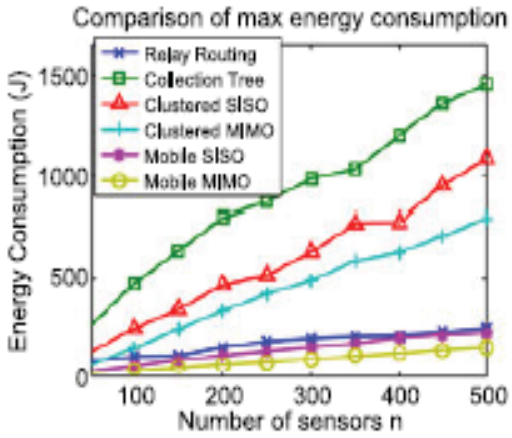

Figure 5. Comparison of maximum energy consumption

The data latency is another issue, lower latency could be achieved in clustered MIMO because here the routing burden is divided among the clusters. It save time in routing for both data aggregation and uploading by using the single-hop transmission. The cluster heads had consuming more energy than other member nodes since this can perform both data aggregation and forwarding. The mobile MIMO consumes lowest energy on the cluster heads using inter-cluster transmission of data packets.

In mobile MIMO the more number of cluster heads are generated for each cluster heads. The energy overhead and the cluster information notifying on SenCar, the energy consuming by MIMO circuitry is very less and it is negligible.

The data message have to be delivered within a given time constraints. The moving SenCar exceeds more number of deadlines if it relax the deadline once then missing deadline percentage will be highly increased. If earlier message deadline is far from SenCar then it as to observe extra moving cost. To reduce the travelling cost on SenCar it should meet all the time constraints and multiple SenCar are used for partition the data collection tour over network.

VIII. CONCLUSION AND FUTURE WORKS

The load balanced mobile data collection in a wireless sensor network employs the load balanced clustering, self-organization, and adopts inter-cluster transmissions. For fast data uploading we use the dual data uploading by MU-MIMO. The result show that it has low routing burden by sharing among different clusters, this reduce the energy consumption and balanced workload among cluster heads. This also saves energy by reducing the data gathering time and very less energy overhead is obtained among cluster heads.

The future work is to develop easy method to find polling points and compatible pairs for each cluster. The new sequenced scheme should be develop to continuous space to locate best polling points. To make proper schedule for MIMO uploading from multiple clusters based on this the algorithm should be studied in future.

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