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An Energy Efficient Optimal Load Sharing Technique in WSN

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Abstract— Wireless sensor networks have become increasingly popular for environmental and activity monitoring, such as temperature, pollution, parking space, traffic, and crowd monitoring. Mobile users can collect and visualize sensing data by communicating with wireless sensors along their walks using Bluetooth or NFC. They can also share the sensing data on the Internet through 3G or WiFi connectivity. Nevertheless, mobile users may not be able to collect all the data from the sensors due to limited contact times and batteries. In this research a review of different techniques to be used for clustering in WSN.

Keywords— WSN, Energy Efficiency, Base Station

I. INTRODUCTION

Wireless Sensor Networks (WSN) consist of hundreds of low cost, energy and computational power sensor nodes and have achieved a widespread applicability in many application domains ranging from precision agriculture and animal welfare to home and office automation. Although sensor network deployments have begun to appear, the industry still awaits the maturing of this technology to realize its full benefits. Due to the limited communication range of sensors, large geographical areas cannot be covered. In addition, a large number of Internet subscriptions are needed to connect cluster heads or base station of each cluster to the Internet in order to relay data from fields to users through Internet.[1] As each sensor network has an individual Web interface, users do not have a complete view of different geographic sensor fields. A large scale sensor network with a common application interface is, therefore, significantly required. In this paper, investigation of a large scale heterogeneous wireless network consisting of three overlay networks is done: (1) sensor network (2) Wi-Fi meshed network and (3) an infrastructure network plane, such as a Wi-Max. The main constraints to large scale commercial adoption of sensor networks have been the lack of available network management and control tools. Such tools include the ability to determine the degree of data aggregation prior to transforming it into useful information, since data aggregation reduces the number of communications and energy consumptions, especially in dense sensor deployment, by aggregating redundant data packets in intermediate nodes.[2] Designing an efficient data aggregation technique is, therefore, very important to efficiently use the resources by reducing communications among nodes. Most existing data aggregation techniques are, however, not designed for large scale WSNs and do not consider the tradeoff between energy efficiency, end-to-end delay and data accuracy. The main contribution of this paper is to propose a data aggregation approach that considers the tradeoff among energy consumptions, fault tolerance and delay using fixed power-supply devices in large scale deployments. Static time driven monitoring provides user with highly detailed and redundant information. For instance, temperature information from each sensor of a field is highly redundant, which causes the depletion of sensor energy very fast. Data Aggregation is an address centric approach where each node sends data to a central node via the shortest possible route using a multihop wireless protocol.[3] The sensor nodes simply send the data packets to a leader, which is the powerful node. The leader aggregates the data which can be queried. Each intermediate node has to send the data packets addressed to leader from the child nodes. So a large number of messages have to be transmitted for a query in the best case equal to the sum of external path lengths for each node.[3]

In-Network Aggregation: In-network aggregation is the global process of gathering and routing information through a multi-hop network, processing data at intermediate nodes with the objective of reducing resource consumption (in particular energy), thereby increasing network lifetime. There are two approaches for in-network aggregation: with size reduction and without size reduction. In-network aggregation with size reduction refers to the process of combining & compressing the data packets received by a node from its neighbors in order to reduce the packet length to be transmitted or forwarded towards sink. In-network aggregation without size reduction refers to the process merging data packets received from different neighbors in to a single data packet but without processing the value of data.[4]

Tree-Based Approach: In the tree-based approach perform aggregation by constructing an aggregation tree, which could be a minimum spanning tree, rooted at sink and source nodes are considered as leaves. Each node has a parent node to forward its data. Flow of data starts from leaves nodes up to the sink and therein the aggregation done by parent nodes.[4]

Cluster-Based Approach: In cluster-based approach, whole network is divided in to several clusters. Each cluster has a cluster-head which is selected among cluster members. Cluster heads do the role of aggregator which aggregate data received from cluster members locally and then transmit the result to sink.[4] .

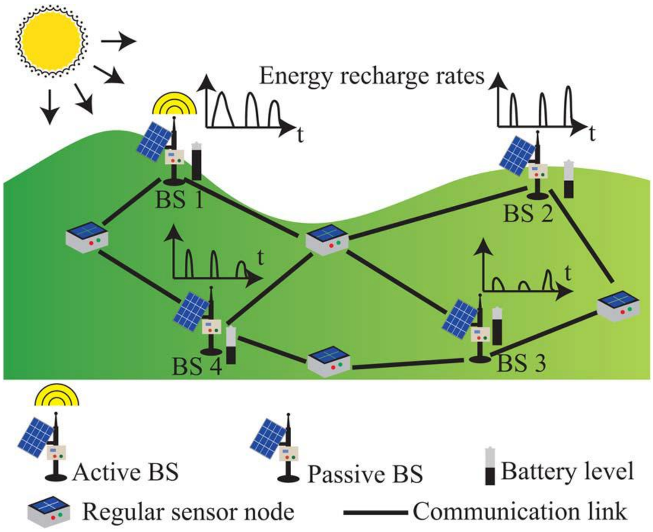

Fig 1. A WSN with the proposed scheme that deploys multiple BSs, keeps only one of them active and adaptively re-selects this active BS. At the current time, BS 1 is active. Sometime later, the active BS will be re-selected based on the states of the network, e.g., battery levels. By using this scheme, the temporally and spatially varying energy resources of all BSs are fully utilized.

II. OPTIMAL LOAD SHARING BY BASE STATION

This approach coordinates the energy resources available to all the deployed BSs such that the sizes of energy sources for individual BSs can be substantially reduced. The idea is to shut down unnecessary BSs and to keep only one active BS, as shown in Fig. 1. To share the high load of being the active BS, this technique adaptively and iteratively select the BS that is activated. The active BS collects data and maintains long-range communication with the remote server. Meanwhile, passive BSs behave as regular sensor nodes. They turn off their long-range communication devices, only sampling and forwarding data by using short-range communication. When the network has connectivity problems and splits into several connected components, the aforementioned active-BS selection process automatically takes place in all these small components. In each connected component, the high energy consumption of using long-range communication for the active BS is shared among all BSs. The batteries of all BSs form a pool, virtually resulting in a larger global power source. To build a sustainable WSN, the requirement is that the total energy harvested by all BSs sustains the consumption of the active BS. Consequently, the size of the individual power sources can be substantially reduced. Because the scheme for coordinating multiple BSs is unique, so it has to solve the following practical issues: (i) when the network is connected, how to start the WSN into the state with only one active BS, (ii) how to adaptively gather the information and decide the next active BS, (iii) how to manage the handover of the active BS and (iv) how to detect and recover from a network split or a failure of the active BS. The solutions provided to these issues are distributed and robust. In each connected component of the network, it has to adaptively re-select the active BS. The first idea coming to one's mind is to use Round-Robin (RR): This technique let all BSs be sequentially active with equal time. However, RR is not necessarily optimal due to the heterogeneity of BSs: (i) The energy recharged from solar panels of different BSs might be different because the solar panels might have different positions, different angles to the sun and different energy conversion efficiency. (ii) The circuit power of different BSs might be different both when being active or when being passive. To achieve the optimal lifetime, different BSs should be active for different fractions of time, and these fractions cannot be computed beforehand due to the unknown profile of the energy recharging process. This paper proposed an adaptive algorithm which enables all BSs to gradually achieve the optimal fractions of active time, i.e., "Highest Energy First" (HEF). This algorithm adaptively selects the BS with the highest available energy to be active. The appealing feature of HEF is that it requires little information as input and yet fits perfectly for the WSN paradigm. The active BS only needs to gather the battery levels of passive BSs. This algorithm is proved to be asymptotically optimal under mild conditions.

1) This approach deploys multiple BSs, keeps only one BS active at a time and adaptively reselects the active BS. By using this scheme, the temporally and spatially varying energy resources available to all BSs are efficiently utilized, and therefore the energy supplies of individual BSs can be reduced substantially.

2) An adaptive algorithm HEF for re-selecting the active BS. This algorithm requires little information exchange in the WSN and is easy to implement. This proposal shows that under certain mild conditions, this algorithm is asymptotically optimal.

3) In this paper discussion of the implementation issues of HEF on real WSNs is done. In particular this paper discussed how to start the network, how to gather the needed information and how to hand over the active BS. The solutions provided are distributed and robust.

4) Evaluate the proposed scheme, simulations on the simulator Matlab and real experiments on an outdoor tested is implemented. To the best of our knowledge, it is the first installation of a real tested with multiple cooperative BSs. The obtained results show that proposed scheme is energy-efficient, has low communication overhead and reacts rapidly to network changes

III. SYSTEM ARCHITECTURE

In this architecture, time is partitioned into slots whose lengths are two hours each. At the beginning of each time slot, one active BS is selected. This active BS begins broadcasting beacons and notifying the whole network. Upon receiving these beacons, passive BSs and regular sensor nodes update their routing tables and forward these beacons. Every sensor node takes sensing samples at a constant rate. The sensed data are then forwarded to the active BS by using short-range communication in a multi-hop fashion. The active BS collects all the data packets and forwards them to the remote server. In the next time slot, the active BS remains the same or it hands over the role to its successor, depending on the output result of HEF. Then, the new active BS starts broadcasting the beacons and the whole process is repeated.

IV. METHODOLOGY

HEF(Highest Energy First): In this section, the algorithm "Highest Energy First" (HEF) for solving the adaptive BS selection problem is defined. In practice, this algorithm is easy to implement because it only requires the battery levels of all BSs as the input. At any time slot n, BS $m*$ $(1 \le m* \le M)$ is chosen to be active during time slot n if and only if its available energy e $(n-1)$ $m*$ is the highest.

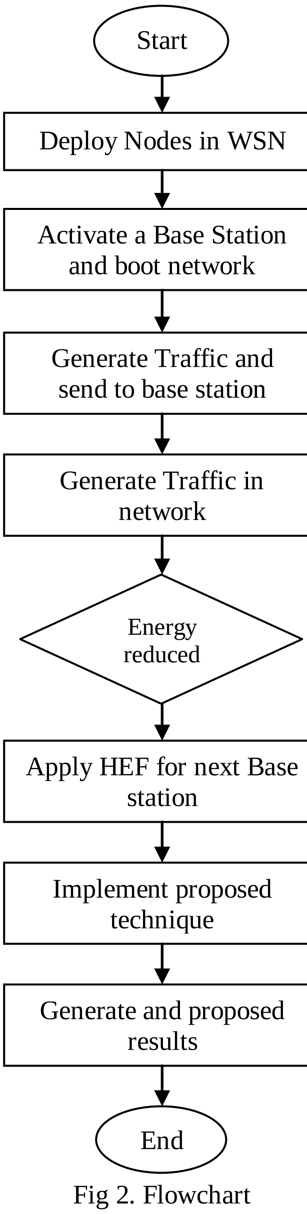

Fig 2. Flowchart

Step 1: In the very first step a network is to be deployed over specified area.

Step 2: After network deployment the Base Station is to be activated and network will boot.

Step 3: Now node will transmit traffic to the base station and introduce traffic in network.

Step 4: The energy of base station is to be check periodically, if it has sufficient energy which can accommodate the packets sent by the nodes.

Step 5: Apply Highest Energy First algorithm in which the node with the highest energy will act as base station.

Step 6: Apply optimal path algorithm and generate results.

V. RESULTS

In current section with the help of comparative study, it can draw all the pros and cons of the above defined scheduling schemes. In this scenario a comparison is made between hybrid routing schemes by taking 25 subscriber stations which is shown below.

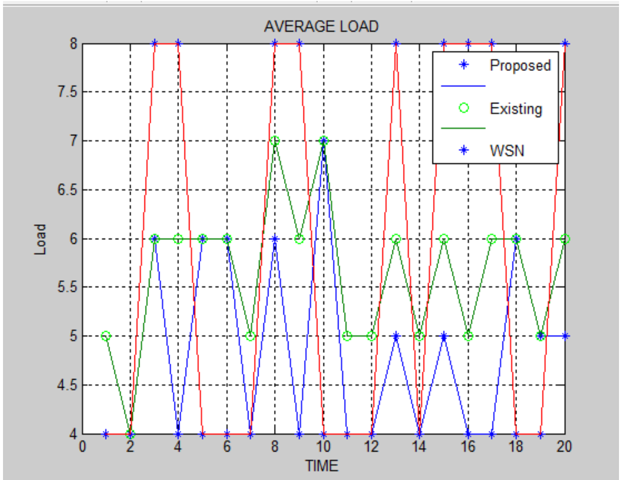

Fig 3: Average load

Load: The load in two WSN protocols existing and proposed scenario in 25 nodes. From the above graph it is shown that the load in proposed approach is less than that of existing scenario.

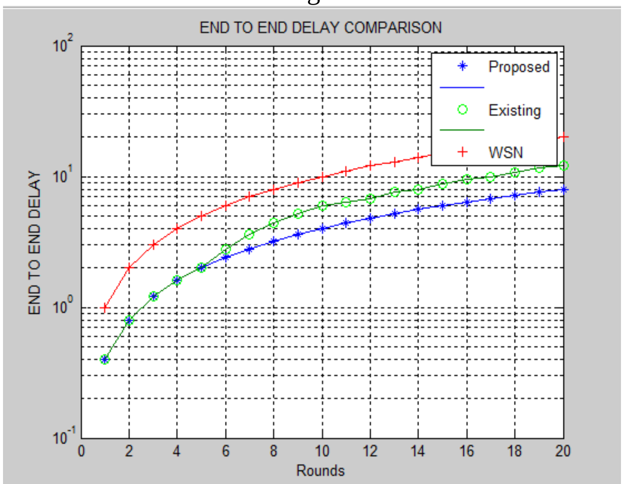

Fig 4: Delay

Delay: Delay in existing and proposed scenario in WSN in 25 nodes. From the graph it can easily depicted that the delay in proposed protocol is less than that of existing scenario.

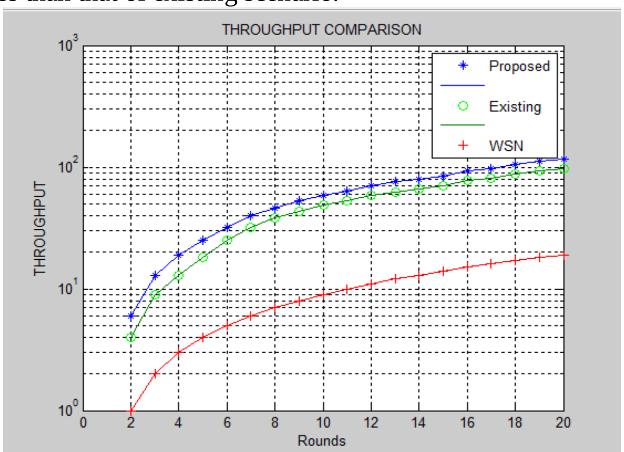

Fig 5: Throughput

Throughput: Throughput in existing and proposed scenario in WSN in 25 nodes. From the graph it can easily depicted that the throughput in proposed scenario is less than that of existing protocol. Throughput in case of proposed case is approx 110 packets and in existing case it is approx 100 packets.

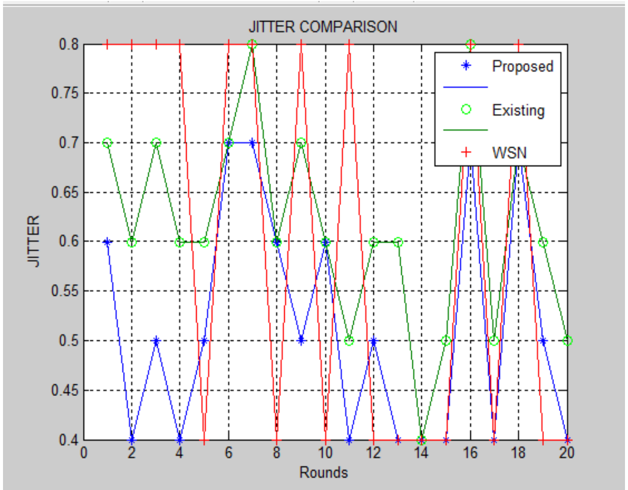

Fig 6: Jitter

Jitter: Jitter in existing and proposed scenario in WSN in 25 nodes. From the graph it can easily depicted that the jitter in proposed protocol is less than that of existing scenario. Jitter in case of proposed case is approx 3.5 sec and in existing case it is approx 7 sec.

Table 1 Comparative study of various parameters for both algorithm

Algorithmic Parameters	Existing	Proposed
Delay(sec)	80	60
Throughput (packets)	100	110
Jitter(sec)	7	3.5
Average Load (bits/sec)	7000	6000

VI. CONCLUSION

The proposed techniques had extensively characterized data collection in Wireless Sensor Networks with Mobile Elements (WSN-MEs). First it is provided a general definition of WSN-MEs, then we presented a comprehensive taxonomy of their architectures, based on the role of the MEs. Furthermore, we discussed in depth the data collection process and highlighted its main challenges. This proposal finally analyzed each topic by a comparative survey of the approaches available in the literature. This analysis also provided hints for open research problems.

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