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Advanced Data Acquisition in Wireless Sensor Networks

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ABSTRACT

Data acquisition in Wireless sensor Networks (WSN) investigate the fundamental question on how fast information can be collected from a wireless sensor network organized as a tree. For solving this problem used a technique called convergecast. This paper first consider time scheduling on a single frequency with the aim of minimizing the number of time slots required to complete a converge cast .Next combine scheduling with transmission power control to mitigate the effects of interference and show that while power control helps in reducing the schedule length under a single frequency scheduling transmissions using multiple frequencies is more efficient.In the existing system use of single frequency results in more interference and more collision, so next uses multi frequency that results in less interference and collision.In the proposed system try to implement cluster based tree construction using multiple frequency so that different nodes communicate with different frequency hence reduces the interferences and collisions than existing system. Also activate the sleep nodes by using a wakeup call in clusters so that problems in one cluster will not affect other clusters. Sleep scheduling also increases the efficiency of the system and activation of sleep nodes reduces power consumption.

Keywords: - Wireless Sensor Networks (WSN), Time Division Multiple Access (TDMA).

I. INTRODUCTION

A Wireless Sensor Network (WSN) is a wireless network consisting of spatially distributed autonomous devices to monitor environmental conditions using sensors at different locations. It consists of a large quantity of low cost nodes which could either have a fixed location or randomly deployed to monitor the environment conditions. The data flow ends at a node called root or sink node. The sensor network is linked to another network using the base station

A wireless sensor network (WSN) consists of sensor nodes capable of collecting information from the environment and the communication is provided using transceivers. The data gathered is then given to the sink node via multihop communication .It is very difficult to replace sensor nodes batteries. The battery power used is much reduced amount and also more over it creates some difficulties in its replacement. This will affect the network performance. The energy conservation and harvesting increases lifetime of the network. Optimize the communication range and minimize the energy usage, we need to conserve the energy of sensor nodes.

II. RELATED WORK

Fast data collection with the goal to minimize the schedule length for aggregated convergecast studied here and also experimentally investigated the impact of transmission power control and multiple frequency channels on the schedule length. Raw data convergecast has been studied in where a distributed time slot assignment scheme is proposed to minimize the TDMA schedule length for a single channel. Here we evaluate transmission power control and compute the lower bounds on the schedule length for tree networks and algorithms are used to achieve these bounds. The efficiency of different channel assignment methods and interference models are compared and propose schemes for constructing routing tree topologies that enhances the data collection rate for both aggregated and raw-data convergecast.The techniques of transmission power control and the multi-channel scheduling have been well studied for eliminating interference in general wireless networks and their performances for bounding the completion of data collection in WSNs have not been explored. Besides we evaluate the impact of routing trees on fast data collection and how data is transmitted from base node to sink node efficiently. Some of the existing work had the objective of minimizing the completion time of convergecast. The problems of aggregated and raw data converge cast which represent two extreme cases of data collection together.

In convergecast scheduling using TDMA the objective is to calculate the minimum achievable schedule lengths using an interference-aware TDMA protocol. In this consider the case where the nodes communicate on the same channel using a constant transmission power, and then also discuss the improvements using transmission power control and multiple frequencies. In Periodic Aggregated Convergecast consider the scheduling problem where packets are aggregated. Here the Data aggregation is a commonly used technique in WSN that can eliminate the redundancy and minimize the number of transmissions, thus saving energy and improving the life time of network also. Aggregation can be performed in many ways by suppressing duplicate messages using data compression and packet merging techniques.

A. Multichannel Scheduling and Routing

Multi-channel communication is the most efficient method for eliminating interference by enabling concurrent transmissions over different frequencies. Although typical WSN radios operate on a limited bandwidth, their operating frequencies are adjusted hence allowing more concurrent transmissions and faster data delivery. Fixed-bandwidth channels are considered here and also explain three channel assignment methods that consider the problem at different levels allowing us to study their pros and cons for both types of convergecast. The channel assignment problem can be viewed in three different levels, they are the link level (JFTSS), node level (RBCA), or the cluster level (TMCP).

1)Joint Frequency Time Slot Scheduling (JFTSS): In JFTSS when the link loads are equal the highest number of packets load to be transmitted , like in the aggregated convergecast and the most constrained link is considered first, means the link for which the number of other links violating the interfering and adjacency constraints when scheduled simultaneously is the maximum. The most loaded or constrained link in the first available slot-channel pair is scheduled first and added to the schedule. Those links which have an adjacency constraint with the scheduled link are removed from the list of the links that to be scheduled at a given slot. The links that have an interfering constraint should be scheduled on different channels on the other hand those links that do not have an interfering constraint with the scheduled link can be scheduled in the same slot and channel

2) Tree-Based Multi-Channel Protocol (TMCP): TMCP is a greedy, tree-based, multi-channel protocol for data collection applications. The network is partitioned into multiple sub trees and based on the condition of minimizing the intra tree interference by assigning different channels to the nodes that resides on different branches starting from the top to the bottom of the tree. Frequency F1 is assigned to the nodes on left branch, frequency F2 is assigned for the second branch and the last branch is assigned with frequency F3 .Time slots are assigned to the nodes with the BFS-Timeslot Assignment algorithm after the channel assignments. The advantage of TMCP is that it is designed to support convergecast traffic and does not require channel switching.

3) Receiver-Based Channel Assignment (RBCA): The algorithm initially assigns the same channel to all the receivers. For each receiver based on SINR thresholds creates a set of interfering parents and iteratively assigns the next available channel starting from the most interfered parent means the parent with the highest number of interfering links .Due to the overlapping of adjacent channel the SINR values at the receivers may not always be high enough for tolerating the interference, during such case the channels are assigned based on the ability of the transceivers to reject interference. It has a set of parents and a number of channels as an input and gives an output as the list of frequencies assigned to the parents. First, a list of interfering parents for each parent is created. After creating the list of interfering parents, the algorithm iteratively assigns the channels. During channel assignment, if the channels are considered to be orthogonal, the node can simply choose the next available channel.

III. PROPOSED SYSTEM

A. System Analysis and Design

WSN has the capability to monitor the hazardous areas like volcano and it is able to run continuously with zero maintenance for a long time in volcanic environment. The wireless sensor networks are used for monitoring eruptions of active and hazardous volcanoes. The low cost, size, and power requirements of wireless sensor networks have a tremendous advantage over existing instrumentation.

1) Problem Definition: Wireless Sensor Network is a collection of sensor nodes arranged in a network. The term convergecast means data from different sensor nodes are collected and is given to a single node called root or sink node and is considered as one of the fundamental operation in wireless sensor networks. In the existing system different nodes are communicated by sending signals to the sink/root node based on a single frequency. We use the concept of TDMA (Time Division Multiple Access) for this, where if 2 nodes competing for the same channel then the channel is divided into 2 based on the time. Instead of using the single frequency, use multiple frequency so that different nodes communicated with different frequency hence reduces the interferences and collisions than existing system it is implemented by using two algorithms. They are a) BFS-Time Slot Assignment b) Local Time Slot Assignment.

Algorithm 1
BFS-TIMESLOTASSIGNMENT
1. Input: T = (V, ET)
2. **while** ET _= φ **do**
3. e ← next edge from ET in BFS order
4. Assign minimum time slot t to edge e respecting adjacency and
interfering constraints
5. ET ← ET \ {e}
6. **end while**

In the Bfs-Timeslot assignment algorithm breadth wise searching is performed level by level.

Algorithm 2
LOCAL-TIMESLOT ASSIGNMENT
1. node.buffer = full
2. **if** {node is sink} **then**
3. Among the eligible top-subtrees, choose the one which has the the largest number of total (remaining) packets, and let it be top-sub tree i
4. Schedule link (root(i), s) respecting interfering constraint
5. **else**

6. **if** {node.buffer == empty} **then**
7. Choose a random child c of node whose buffer is full
8. Schedule link (c, node) respecting interfering constraint
9. c.buffer = empty
10. node.buffer = full
11. **end if**
12. **end if**

In the Local-Time slot assignment time slots are assigned for each node and hence data send from base node to sink node. Data transmission based on timeslots.

2) Trust Management: In the proposed system sleep nodes are used by using wake up calls so that we can send the information to the root node faster. It also reduces the power consumption. The link table entries would expire prematurely for routing algorithms if an intermediate node sleeps and shuts off all links to its neighbours without any prior notification which will force the rerouting of frequent packet. In the application layer real-time data reporting functions are subject to constant and debilitating routing path breakages due to random sleeping nodes. So in order to solve such problems we use sleep scheduling. The following list of steps concisely describes the process in determining the initial sleep schedules at network initialization.(i)Each of the node learns of its 1-hop neighbours(ii)After that each node forwards local link state information to data sink.(iii)Data sink then computes optimal SS-Tree structures and sleep schedules with respect to the global connectivity map and the application requirements.(iv)Data sink disseminates the computed sleep schedules to every node through source routing(v)Each of the node exchanges sleep schedules with all 1-hop neighbours(vi)Each node then follows its received sleep schedule to rotate between the active states and the sleep states.

Sleep scheduling is an integral part of WSN design compatibility issues of spanning tree management and sleep scheduling should be investigated with prudence. Random sleep scheduling is not recommended, the reason behind it is it would exert a detrimental effect on network connectivity and topology maintenance efficiency. On the other hand implementing a global coordinated sleep schedule for all of the nodes is feasible on a spanning tree structure. A network wide communication blackout exists during the long sleep periods where none of the nodes would be active for the packet forwarding. This will adversely affect the effectiveness in temporal coverage timely reporting of the emergency events.

In the proposed system first we start with initializing the network then we convert it to the cluster based tree structure and identify the hop levels. It involves two process cluster head selection and establishing clusters. The pointer is moved to the last level, for each level data is collected and it is given to the level above and hence to the root node. We calculate the hop displacement and also identify the centre node apply the sleep scheduling on clusters which improves the efficiency and reduction of power consumption

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B. Scheduling Algorithm

- Start
- Initialize the network.
- Convert network to tree structure and identify the hop levels.
- Calculate hop displacement.
- Identify the centre node.
- Cluster establishment using cluster head selection and establishing clusters.
- Construct cluster based tree.
- Calculate the Sleep time
- Apply sleep schedule to hops
- Monitor critical events
- For levels do
- for each node
- Get-together of the Data and transferring of the data to the (level – 1) node
- Collect the data in level – 0
- Stop

C. Modules

1) Network identification*:* Here initialize the network and convert the network to the tree structure and identify the hop levels. Next we calculate the hop displacement and after that identify the centre node or the sink node.

2) Cluster establishment: Cluster head selection consists of two steps they are cluster head selection and establishing clusters. In cluster head selection we compare each node energy based on a threshold value and if it is above that value the sink can count it as cluster head else not. In establishing clusters after selecting the cluster heads, the sink computes the distance between the cluster heads and sensor nodes according to the coordinate information. Each node is selected after that to join the cluster head by cluster. The sensor nodes will compare the distance with each cluster head and will then label the node's identity and that it has been selected to join a specific cluster.

3) Construction of cluster based tree: The sink will collect the information that each cluster head has labelled in each cluster and builds a minimal distance path to compute the tree path. Here a cluster based tree is constructed so that the cluster can manage small load balancing of the source node and implement sleep scheduling on clusters.

4) Sleep scheduling*:* Sleep scheduling is implemented in clusters so that it result in less power consumption .we are reducing the load to sink node via clusters and by using wakeup calls implement sleep scheduling.

5) Processing: In processing data is transmitted efficiently from base node to the level just above it and hence reach cluster nodes and from there data send to root node.

IV. CONCLUSIONS

Analysed how fast converge cast in WSN where nodes communicate using a TDMA protocol to minimize the schedule length also the limitations due to interference and half duplex transceivers on the nodes and explored techniques to overcome the same. Here found that while transmission power control helps in reducing the schedule length multiple channels are more effective. Here found out how data can be effectively transmitted from base to source node using cluster based tree structure by using clusters it reduce the load of sink node. Once interference is completely eliminated we proved that with half duplex radios the achievable schedule length is lower bounded by the maximum degree in the routing tree for aggregated convergecast and by for raw data convergecast. Using optimal convergecast scheduling algorithms we showed that the lower bounds are achievable once a suitable routing scheme is used. Lastly also propose sleep scheduling in each clusters for reducing the power consumption using wakeup call so that problems in one cluster will not affect other clusters.

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