Real Time Routing in Wireless Sensor Networks

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Abstract - *As the sensor nodes have limited energy resources, the protocol designed for the wireless sensor networks should be energy efficient and provide low latency. Conventional routing protocols such as LEACH, PEGASIS, CCS and TSC use fixed deployment of nodes. Here we compare adaptive CCS and adaptive track sector clustering scheme when the nodes are deployed randomly in the network and the cluster head (CH) are chosen with respect to minimum distance from the base station (BS). The simulation results show that adaptive TSC performs better compared to other protocols when the nodes are deployed randomly*

Keywords— *Wireless sensor network, Base station, Cluster Head, Network, Random deployment*

I .INTRODUCTION

Wireless Sensor Network (WSN) is a network of wireless embedded system elements, which consists of spatially distributed autonomous devices using sensors to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants at different locations The main function of these sensors is to sense an event occurring in their area and route the sensed data to the Base station (BS). Nodes may communicate in ad-hoc way in order to extend the communication range and maintain network scalability. The main WSN limitations are battery capacity, bandwidth and computing power. Hence, routing techniques must be applied to provide long-range and large-scale communication in WSN.

Wireless sensor networks consist of a huge number of sensor nodes. Mainly all of them are battery powered. Routing algorithms should always be power aware because sensor network lifetime is equal to sensor node lifetime, i.e. when the first node in a network dies, the network can be considered as dead.

In general, routing in WSNs can be divided into flat-based routing, location-based routing and hierarchical-based routing depending on the network structure [7].

In flat-based routing, all nodes are typically assigned equal roles or functionality. In location-based routing, sensor node's positions are exploited to route data in the network. In hierarchical-based routing, however, nodes will play different roles in the network here clusters are created and a head node is assigned to each cluster. These head nodes collect and aggregate the data from their respective clusters and transmit the aggregated data to the BS. The aggregation of data at head nodes greatly reduces the energy consumption in the network by minimizing the total data messages to be transmitted to the BS. Also, the head nodes act as local sinks for the data, so that the data are transmitted relatively over a short distance.

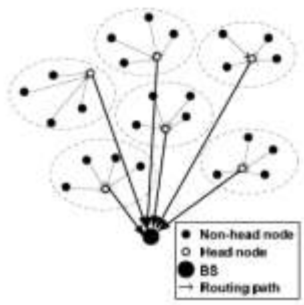
Manual node deployment is difficult when the number of nodes increases noticeably but, in this case predefined routing paths is possible. Random deployment is less costly, but this increases the complexity of routing algorithms.

There are many routing schemes which are based on hierarchical-based routing such as low energy adaptive clustering hierarchy (LEACH),energy LEACH, multi-hop LEACH, LEACH-C, power efficient gathering in sensor information system (PEGASIS) concentric clustering scheme (CCS) [1-5] Track sector clustering (TSC)[9] proposed in are effective in conserving energy. However, these conventional routing protocols have used fixed deployment of nodes and compared the results.

In this paper we compare the adaptive CCS and TSC routing algorithm where the nodes are randomly deployed in WSN. We check the energy performances and the number of nodes alive in the network for randomly deployed nodes..

II. EXISTING ROUTING SCHEMES

LEACH [1] is the first clustering scheme, here the network is divided into clusters the nodes organize themselves into to the clusters, in each cluster a CH is selected, every node in the cluster send the data to their CH and the CH in turn sends the data to the BS.



PEGASIS[4] a near optimal chain based protocol in which a chain is formed among the sensor nodes so that each node will from and transmit to a close neighbours, the gathered data moves from node to node, get fused and lastly the CH selected for that node will transmit the data for BS. Thus PEGASIS reduces the energy consumed than LEACH as nodes need to send data to its neighbour where as in LEACH they need to send to CH only, here the CH receives only one data message where as in LEACH the CH receives the data equal to number of nodes in the cluster.

To reduce the energy consumption in the PEGASIS protocol a new routing scheme called CCS [5]. is proposed here the network is divided into concentric circles called tracks each track represents a cluster. Within the cluster the chain is constructed based on PEGASIS scheme. A CH is selected in each cluster which transmits the data to the CH in the lower tracks, the nearest CH to BS will aggregate all the data from CH's of the above tracks and send it to the BS. Here the distance over which the data have to be transmitted to the BS from the head node is reduced and the reverse flow of data from BS is reduced.

To reduce the energy consumption in the PEGASIS protocol a new routing scheme called TSC [9] is proposed here the network is divided into concentric circles called as tracks as done in CCS further the tracks are divided into sector's, the sectoring is done at an angle of 60^o here the number of cluster's are increased but distance the data should travel is reduced. This protocol uses the same idea used in CCS here the choosing of CH is different. The CH in the lower track is chosen randomly then the slope with which the CH is subtended with the BS is calculated. Based on this slope the CH in the higher tracks is chosen. Here the distance over which the data have to be transmitted to the BS from the head node is reduced hence the energy consumed is reduced.

III PROPOSED ALGORITHM

Here we use Adaptive track sector clustering .In this algorithm we are deploying nodes randomly in the network, where as in TSC the nodes are fixed, the tracks are selected depending on the distance of the node from the base station and the sectors are subtended at an angle of 60° at the BS. As the distance between the nodes in a cluster are different the nodes sends the data to neighbouring node based on the shortest path between the nodes with in the cluster. The choosing of CH is also different than TSC here the nearest node from the base station is chosen as the CH in each cluster. The cluster head in the upper track sends the processed data of its cluster to the CH in the lower track. The CH's in the lowest track send the all processed data of previous CH's and its cluster to BS. The proposed protocol is as shown in figure (2).

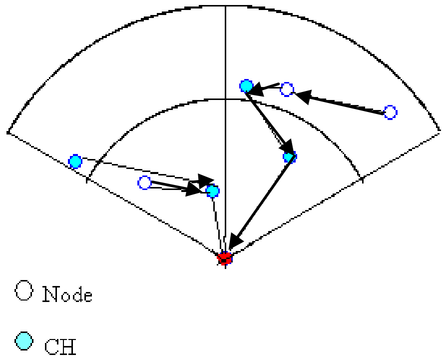


Figure 2. Adaptive track sector clustering

IV. OPERATING PHASES

The operation of Adaptive track sector clustering is broken up into rounds:

Advertisement Phase:

In this phase each node sends the details of its location, coordinates. Every node sends a "Hello packet", the hello packet consists of #Sink ID# Packet ID# Node ID#

Cluster Setup Phase:

After each node has decided to which cluster it belongs, it must inform the next node that it will be a member of the cluster finally the node nearest node to the CH will transmit the data to it. Finally each node transmits this information back to the cluster-head again using a CSMA MAC protocol by using an "Echo packet". The echo packet consists of #Sink ID# Packet ID# Node ID#. During this phase, all cluster-head nodes must keep their receivers on.

Schedule Creation:

The cluster-head node receives all the messages for nodes that would like to be included in the cluster. Based on the number of nodes in the cluster, the cluster head node creates a. TDMA schedule telling each node when it can transmit. This schedule is broadcast back to the nodes in the cluster

Data Transmission:

Once the clusters are created and the TDMA schedule is fixed, data transmission can begin. Assuming nodes always have data to send, they send it during their allocated transmission time to the cluster head. It is done using a "Broadcasting packet", the broadcasting packet has the following information's #Sink ID# Packet Type# Packet Length# Sense ID# Parent ID# Sense Type# Sense Data#.

Information Transmission:

Once the data has been broadcasted from a node the next node will be updated, it will process and decode the data, and then it transmits the aggregated data to

the next node or CH in the form of "Info Packet", the info packet has the following information's:
#Sink ID# Packet Type# Packet Length# Node ID# Parent ID# Previous Node ID# Current Node ID# Sense Type# Sense Data

V. ENERGY ANALYSIS

In this paper we use formal radio model [6] [8] to compare the performance of adaptive CCS and TSC protocols, variables used in this paper are in table 1.

Table.1 Variables

Type	**Parameter**	**Value**
Transmission amplifier	ϵ_{amp}	10^{-5}J
Data Bit	K	2000
Transmission electronics	E_{elec}	10^{-4}J
Energ for processing	E_{agg}	0.5J

To Transmit *K* bit data message at a distance *d* using the radio model

$$E_T(k,d) = E_{elec} \times k + \epsilon_{amp} \times K \times d^2 \qquad (1)$$

The energy consumption in one round is formulated as

$$E = N \times E_{elec} \times K + \epsilon_{amp} \times K \times \sum_{n=1}^{N} d^2_{(n-1,\, n)}$$

(2)

Here'd' is the distance between the consecutive nodes or the distance between the CH in the upper track and the CH in the lower track

VI. SIMULULATION ENVIRONMENT

We used Mat lab for performance evaluation of scheme [10] [11]. For our simulation we used a network of 100 nodes deployed in an area of 30*30 m with BS at centre (0,0). We set the initial energy of each node to 8 J. The number of tracks was chosen by network as 2. Since the BS is located at the centre, number of sectors was chosen as 6 so that each sector projected an angle of 60° at the BS. Each sector had variable number of nodes. We assumed that no energy was consumed when the node stayed idle or went to sleep and the energy was spent only during data transmission and reception. The simulation time was set to 250 seconds.
Here the nodes are randomly deployed in the network, based on the distance from the base station the nodes are put into different tracks, the sectoring is subtended at an angle of 60° at the BS, once the clusters are formed it is fixed for that simulation time, within a cluster the nearest node from the BS is chosen as the CH.

VII. RESULTS

Based on the formulas that we have mentioned above we compute the total residual energy and the number of alive nodes over the simulation time of 0 to 750 seconds
Figure (3) shows the residual energy of both adaptive CCS and TSC .as shown in Figure (3)
The adaptive TSC protocol performs better than adaptive CCS.

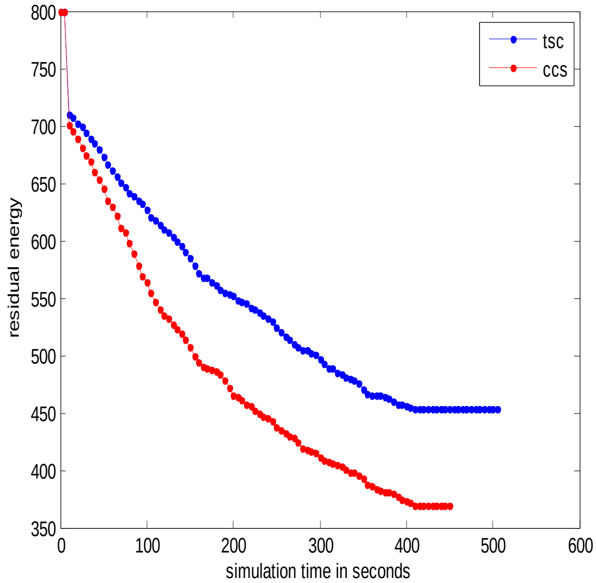


Figure 3.Residual Energy

Figure (4) shows the no of alive nodes in the network over the simulation time
The number of nodes alive in adaptive TSC is better than adaptive CCS

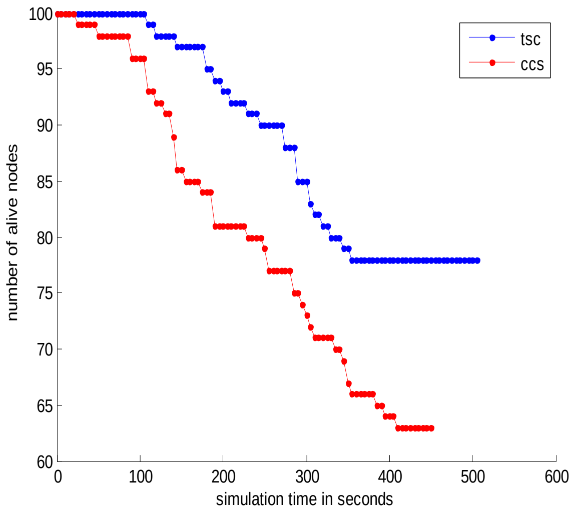


Figure 4. Number of Alive Nodes

Table2 shows the comparison of adaptive TSC and CCS over the simulation time

Table. 2comparision of adaptive CCS and TSC

	CCS	TSC
First Node death(sec)	25	110
Number of alive nodes	63	78
Residual Energy (Joules)	369.5	453.2

VI.CONCLUSION

In this paper we have examined the energy efficiency of the network when the nodes are randomly deployed in the WSN. we have compared the 2 algorithms adaptive TSC and CCS Where adaptive TSC performs better than adaptive CCS in terms of energy consumed , number of alive nodes and death of the first node .

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