Power Efficient Data Collection in Wireless Sensor Networks

Shamimul Qamar, Niranjan Lal

Abstract*: Wireless sensor networks experiencing exponential growth in the past decade. In almost all areas it is required to manage and monitor the devices with low cost solutions and proper localization process for communication that manages the sensor nodes across the globe, there are many applications those are possible by wireless sensor networks in today's era like smart home, environmental monitoring, smart traffic management etc. proper identification and communication setup is very important task, especially in Internet of Things or Internet of Everything, among the different sensor nodes in the network and other mobile devices. Designing an efficient, reliable, scalable, and cost-effective localization process is required for the effective communication. Using wireless sensor network, we can access, monitor, and collect the useful information remotely like temperature, humidity, vibration, acceleration. In this paper we have identified issues related to consumption of energy in wireless sensor network (WSN). In wireless sensor network, sensor nodes are deployed randomly to collect the useful data and information from different applications for further processing. Sensor nodes may be located on different locations, in staring we collect the raw data from sensor nodes that will store at remote base station known as sink. As the sensor nodes are located on different geographical locations which have limited battery power and life time. The sensors node battery life is different parameters like traffic intensity, communication channel. There are many researches are going on this area to maximize sensor's lifetime by using routing mechanism. In this paper, we have proposed LEACH and PEGASIS approaches for improve lifetime of sensor node in wireless sensor networks. Firstly, we have discussed the primary routing challenges, and secondly, in this paper we have covered design area of routing in wireless sensor network with modulation techniques to design efficient routing protocols for wireless sensor networks.

Index Terms: Data collection; node; style; wireless sensor network;

I. INTRODUCTION

As wireless Sensor Networks is the combination of many micro sensor's nodes, which are connected by a wireless medium, due to size of sensor nodes, nodes can be deployed, support and work with various applications and situations for stationary or mobile sensor nodes. Deployment of the sensor is based where node will be use and application. After deploying the sensor nodes, the maintenance cost of the nodes is very less, these nodes are used to for specific purposed as per the application area.

The important work in wireless sensor network is use to collect the data received at sensor nodes to a particular storage for the analysis purposed, due to analysis of data, the energy consumption of the wireless sensor node is decreases days. To solve problem of conception, a movable sink can be used, mobile phones can be used as a sink for the collection of data and after analysis send the updated information to base station, to collect the data efficiently the patterns and mechanism should be decided before collection for data that can reduce the collection time in the sinks.

The main motivation of our research is to increase the lifetime of sensor node in WSN's because due limited energy and limited resources to recharge and, to construct a new energy efficient routing protocol based on optimal path. Besides the conventional protocol of direct transmission, there are two other protocols LEACH and PEGASIS can be used to maximize the lifetime of a nodes.

II. LIFETIME OF WIRELESS SENSOR NETWORKS

The sensor node consists of nodes in hundreds and thousands in numbers which can sense various parameters like temperature, sound etc and perform various required computations and also can set up communication with other sensors in the same network. Wireless network is setup in the interested area and the nodes are scattered randomly for number of applications such as distributed computing, fault detection and diagnosis, security and tactical surveillance, defence operations, etc. The nodes sense the required data and sends their gathered data to destination nodes through relay nodes, which is connected to central depository also called base station. The base station is connected to the outside world through wired or may be wireless network [1].

Wireless sensors era is exponentially growing area now days; it received attention in the past years due to its popularity with effective cost in all environments, there are many applications area wireless sensor network is very useful like; military applications, application for checking environmental conditions (temperature, humidity, weather conditions etc.), health applications, industrial or commercial applications and home applications. Wireless sensor nodes are very cost effective and they can be easily deployed in all areas, harsh environment, and even blow the surface level in water but they are having limited power and battery lifetime. If power is down and exhausted, the sensors become dead and un-useful and no more for use.

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In this case there should be a approach or evaluation process that can evaluate the life cycle of a wireless sensor network of sensor nodes to estimate and check the life of network and how long time it can be live, so we can replace or recharge the sensor nodes in wireless sensor network environment.

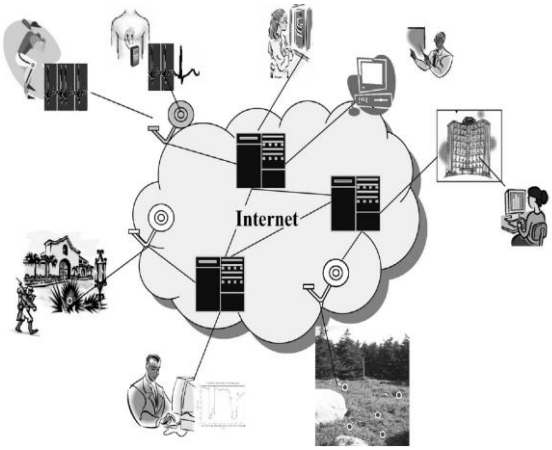

Figure 1: Wireless sensor Network Scenario

Table 1: Simulation Parameters

Parameters	values
Base station location	60m,180m
Number of nodes	125
Data packet size	250 bits
Initial energy	2.5 J
Round time	20s
Energy dissipation	55 nJ/bit
Multipath model of transmitter	0.0012pJ/bit/m4
Free space model of amplifier	15 J/bit/m2

III. Data Dissemination and Gathering

For reducing the unnecessary communication, we can aggregate the data we have collected from different sensor nodes that will be useful before sending to the base station. It reduces the number of messages transmitted to save the energy that wasted in communication.

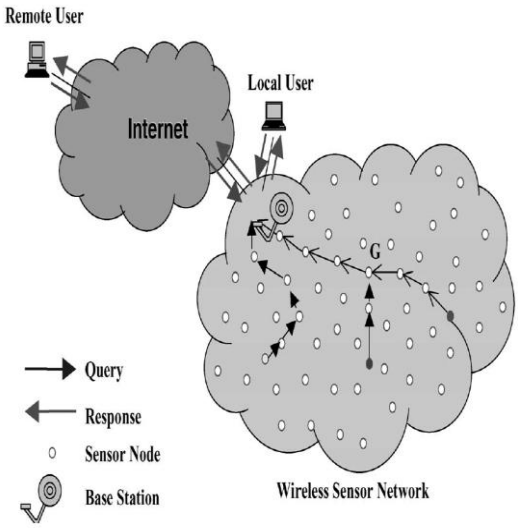

Figure 2: Wireless Sensor Network Structure

There are many data models and algorithms are exits to use the sensor nodes in various application, some algorithms or models can increase the complexity of routing design in wireless sensor nodes, therefore right data model or algorithm selection will be good to optimize the routing protocol for different applications. In this paper our main motive is to decrease the complexity of data models and optimizing the routing protocols for diverse applications. The compatibility of the data model is the main issue in wireless sensors network that can deliver the highest performance with reliably, scalability and power efficiency of the sensor nodes.

IV. Literature Survey

In this section we have described two protocols LEACH and PEGASIS similar to our research work. These protocols are mainly designed to gather the data efficiently from sensor nodes and forwarding the data to the sink nodes in proper way to save the energy and increasing the lifetime of sensors. The Low-Energy Adaptive Clustering Hierarchy (LEACH) [13] protocol is shown in Figure 3, where sensors are shown as clusters fusion and nodes are divided as cluster heads and simple nodes, cluster heads are used to collect the data from simple nodes and finally collected data is send to sink nodes. This protocol is the right option for data collection and transmission between sink and nodes.

The main issues in LEACH protocol is have many cluster heads due to its dynamic clustering, if any cluster head die in this protocol, cluster members will be failing, they will not be able to forward or send the collected data to sink node.

To overcome the problem of LEACH protocol, we can create the extra head, for creating extra heads, the Power Efficient Data-Gathering Protocol for Sensor Information Systems (PEGASIS) [14] is the right solution, which collects the data in the form of chain. This protocol is shown in Figure 4 with linear chain of the eight nodes, where first neighbor node is identified and collect the data than received data is forwarded to next node then in the form of chain and this process continues until the cluster head node sends the data to the sink.

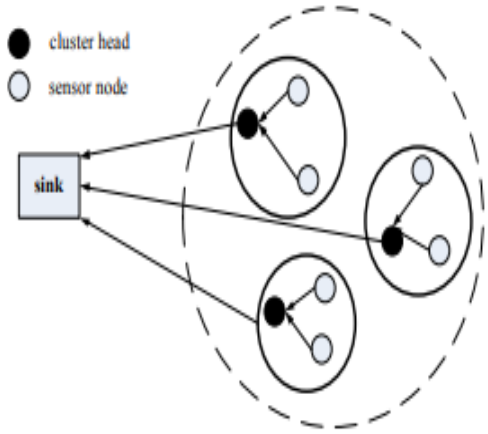

Figure 3 LEACH Protocol Network structure

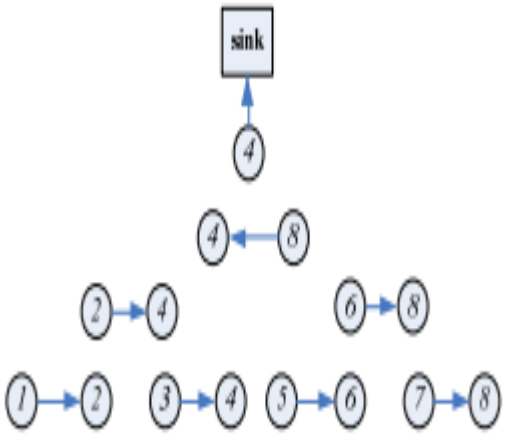

Figure 4 Chain in PEGASIS

V. Energy Efficient Routing Strategies in Wireless Sensor Networks

The main trade-off in wireless sensor network is between responsiveness and efficiency, which is the difficult challenge to handle the problem in wireless sensor networks. To increase the energy, lifetime and communication capability of the nodes we have to take care about these issues and we have to balance this trade-off. to accept and adapt the changes. Finding a better approach to handle this problem is the main challenge task in routing.

In wireless sensors network routing algorithms are categorized according to the nature of data in which they are collecting and managed. It can be identified using proactive, reactive, and hybrid strategies [6]. First, proactive approach is table driven, relies on periodic dissemination of routing information to maintain the accuracy and consistency of the table across all nodes of the network.

Traditional routing algorithm and approaches are not suitable for highly dynamic, and overhead on protocol can be increased with increasing of network size due to dynamic property, where large overhead can easily overcome network resources. For the design of design of protocols in wireless sensor networks, power limitation and other resources, we have to consider because the wireless channel's time-varying quality, due to packet can be loss with delay. To solve this problem of design, there are many routing strategies for wireless sensor networks have been proposed.

In first class of routing protocols nodes are considered as peer in flat network architecture, this approach having many advantages like minimal overhead, fault tolerance.

In second class is based on location and relevant query used to address a sensor node, which is suitable where sensor node's position within the geographical coverage of network and relevant to the query.

VI. Power-Efficient Gathering in Sensor Information Systems

To gather the data efficiently, the PEGASIS is used, in which sensor nodes can collect the data and send to nearest neighbour.

The main aim of this protocol is to extend the lifetime of a network by achieving sufficient level of efficiency and uniform energy consumption across all network nodes, and reduce the delay that data incur on their way to the sink.

In this protocol nodes are organized in the form of chains which uses the greedy algorithm to accomplish this chain. In this protocol network model is used as homogeneous set of nodes to deploy the nodes in the geographical area, where nodes a have memory with controlling power and arbitrary range. If any node will die in this protocol, the chain can be reconstructed to collect the data and send to the nearest node.

Our proposed block diagram of algorithm for wireless sensor network is shown in Figure 5.

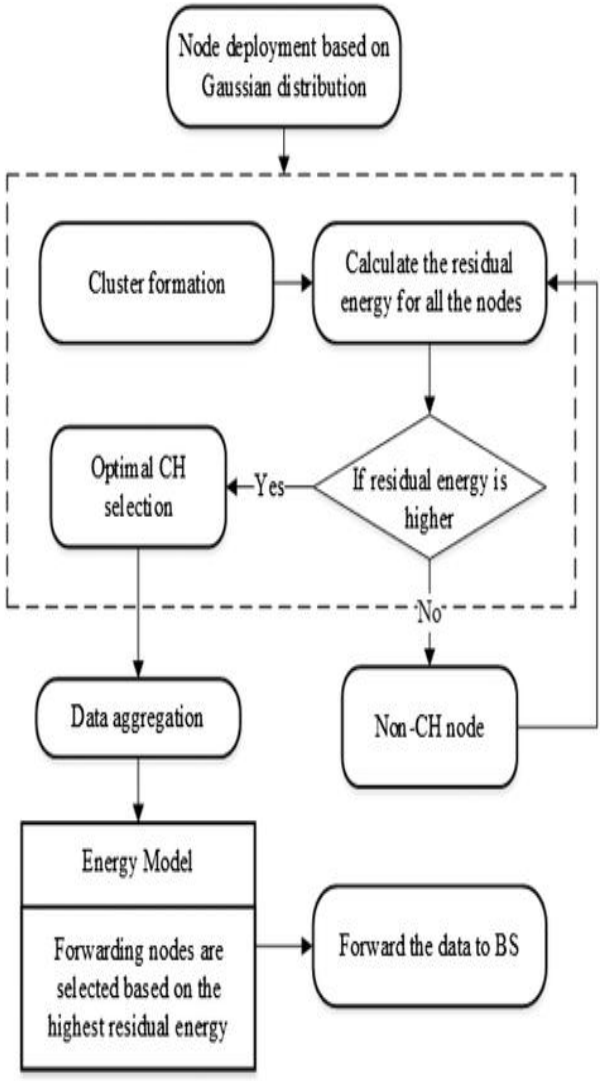

Figure 5: WSN Algorithm Blok diagram

In wireless sensor network a node can have CDMA-capable radio transceivers, that node can gather the data and forward it to base station or sink of the network.

The goal of this paper is to develop a routing structure in which a sensor node can gather and aggregate the data to reduce energy consumption and efficiently send the messages to base station without any delay across the networks.

PEGASIS is based on the chain structure, where nodes can communicate with nearest nodes. In this case for the construction of chain, we considered the farthest node from the sink, and then consecutively other nodes in the network are added to chain from start node to last node.

For outside nodes the greedy approach is used for the construction of chain, in which keep the nearest neighbor on the top in the current chain, until all nodes are included. For finding the closet neighbour node find the signal strength those measures the distance to all its neighboring nodes. In this signal strength is set as only closest node can be heard. In chain, one node is selected as the chain header which is responsible to transmit the aggregated data to the base station. In this approach, after each round, the role of the chain leader is changed and also shifts its position. The distribution of node in PEGASIS is shown in Figure 6.

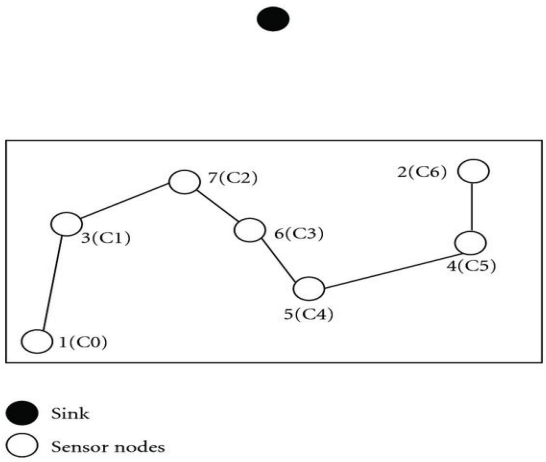

Figure 6: Distribution of Nodes

In PEGASIS each node can receive the data closet node and send to another close neighbors considering as a chain header that role will change after each round and send the data to base station also.

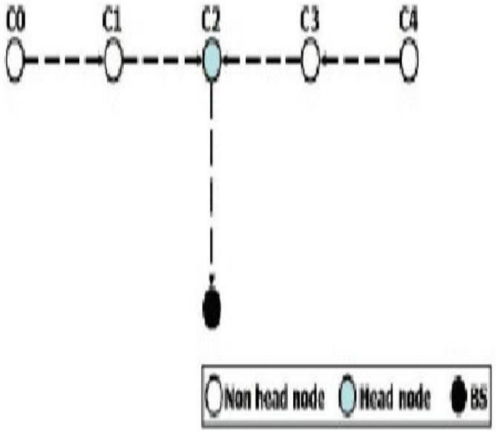

Figure 7: PEGASIS Token

In Table 2 we have shown the different network performance parameters over the life cycle of the network, Table 2 shows network as dead after 10 cycles.

Table 2: Total number of dead sensor nodes and alive over the life cycle

Time	Dead sensors	Alive sensors
1	0	50
2	3	46
3	3	46
4	5	44
5	6	42
6	9	40
7	14	36
8	15	36
9	15	32
10	18	30

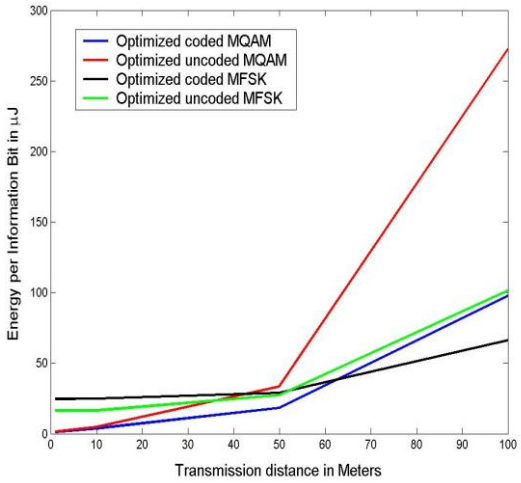

Figure 8: Energy consumption on different modulation

VII. Conclusions and Future Work

In this paper we have discussed two routing protocols for increasing energy efficiency in wireless sensor network, which is the main drawback for wireless sensor networks. In this paper we have given a approach that can overcome this energy efficiency problem in wireless sensor network with renewable charge cycles and an efficient routing protocol scheme. By using our proposed approach vacation time can be maximized charge cycle time with optimizing the free time slot using greedy and shortest path algorithms.

The PEGASIS provides the better performance in place of LEACH.

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