Review of Sensor Node Deployment Strategies in Wireless Sensor Networks

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ABSTRACT *In this paper some node deployment strategies are reviewed to understand the need of proper deployment of sensor nodes. Unlike traditional networks, a WSN has its own design and resource constraints. Resource constraints include a limited amount of energy, short communication range, low bandwidth, and limited processing and storage in each node. The size of the network varies with the monitored environment. For indoor environments, fewer nodes are required to form a network in a limited space whereas outdoor environments may require more nodes to cover a larger area. Wireless sensor networks contain hundreds or thousands of these sensor nodes, and these sensors have the ability to communicate either among each other or directly to an external base station.*

***Key words:** sink, multi-hop, group clustering.*

1. Introduction :

Modern wireless sensor networks are made up of a large number of inexpensive devices that are networked via low power wireless communications. Wireless sensor networks (WSNs) have gained worldwide attention in recent years, particularly with the proliferation in Micro-Electro-Mechanical Systems (MEMS) technology which has facilitated the development of smart sensors. Smart sensor nodes are low power devices equipped with one or more sensors, a processor, memory, a power supply, a radio, and an actuator. Advances in hardware and wireless network technologies have created low-cost, low power, and multifunctional miniature sensor devices. Sensor network is composed of a large number of sensor nodes, which are densely deployed and are prone to failure.

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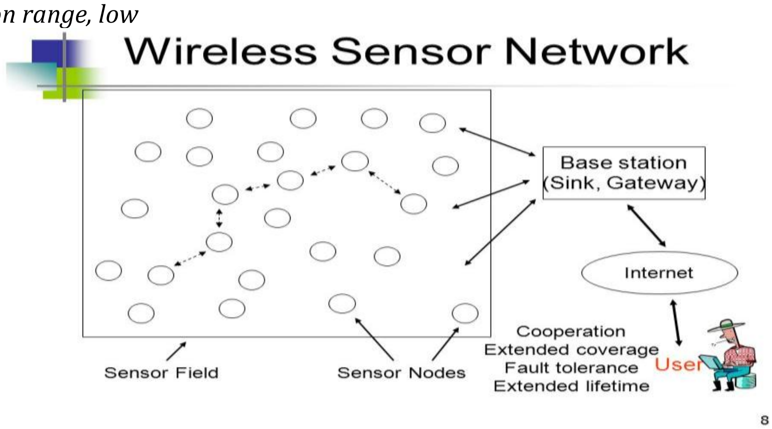

Fig No.1

II. Sink or base station:

A Sink or base station actions like an interface between customers and the network. One can retrieve required information from the network by injecting queries and gathering results from the sink. Typically a wireless sensor network contains hundreds of thousands of sensor swellings. The sensor nodes can communicate among themselves using radio signals. A wireless sensor node is furnished with sensing and computing devices, radio transceivers and power components. The individual nodes in a wireless sensor network (WSN) are inherently resource constrained: they have limited processing speed, storage capability, and communication bandwidth. After the sensor nodes are deployed, they are responsible for self-organizing an appropriate network groundwork often with multi-hop communication with them. Then the onboard sensors start gathering information of interest. Wireless sensor devices also respond to queries sent from a "control site" to perform specific instructions or provide sensing sample. A wireless sensor network is a group of specialized transducers with a communications infrastructure for monitoring and recording conditions at diverse locations. Commonly monitored parameters are temperature, moisture, pressure, wind direction and speed, illumination intensity, vibration intensity, sound intensity, power-line current, chemical concentrations, toxin levels and vital body functions. A sensor network consists of multiple detection stations called sensor nodes, each of which is small, lightweight and portable. Every sensor node is equipped with transducer, microcomputer, and transceiver and power source. The transducer generates electrical signals based on sensed physical effects and phenomena. The microcomputer procedures and stores the sensor output. The transceiver receives commands from a central computer and transmits data to that computer. The power for each sensor node is derived from a battery.

III. Multi-hop WSN:

In a multi-hop Wireless Sensor Network (WSN), each sensor forwards the sensed data to the sink via other intermediate sensor nodes. Hence individual sensor nodes act as the data originator as well as the router. Sensor nodes are generally battery-powered, hence severely energy-constrained. Most of their energy is depleted in the process of data communication. When the battery power is exhausted, a node fails to operate and the node is said to be dead. This ends the lifetime of the network. Therefore, it is obvious that due to the multi-hop sink-centric traffic, nodes nearer to the sink will carry heavier traffic and will deplete their energy faster, creating energy holes around the sink [1], [2]. Hence, in a multi-hop WSN, it is a challenging issue to exploit energy of all the nodes uniformly so that the network lifetime can be maximized. Data gathering with load balancing in terms of power demand at each individual node may be an efficient approach to enhance the lifetime of the network. In some applications with high data correlation, routing with data fusion has emerged as a useful paradigm for load balancing. But even for a very simple network, computing the most balanced data gathering routes is an NP-hard problem. To alleviate the problem, multiple data sinks, or relay nodes can be deployed to collect data. However, general rules for the exact distribution of the sinks, or relays are yet to come up. With uniform node distribution and continuous traffic, in authors have shown that under certain conditions the energy hole problem is unavoidable. In many applications, the sensor nodes are battery-powered, and without any recharging facility. Most of the energy of the sensor nodes is depleted in the process of data communication. When the battery power is exhausted, a node fails to operate and conventionally this ends the lifetime of the network which is the time duration of network operation until the first node fails, mainly due to energy shortage. Hence for energy-efficiency, it is a fundamental issue to reduce the total number of packet transmissions in the network. The network load, i.e., the total number of packets to be delivered to the sink node is lower bounded by the coverage constraint. Given that bound, it is obvious that, each packet should follow the path with minimum hop to reduce the total number of packet transmissions. But, if nodes always forward their packets to the sink node via minimum hop paths, nodes nearer to the sink will carry heavier traffic and will deplete their energy faster, creating energy holes [9] around the sink. Hence, in a multi-hop WSN, it is a challenging issue to exploit the energy of all the nodes uniformly so that the network lifetime [10] is maximized.

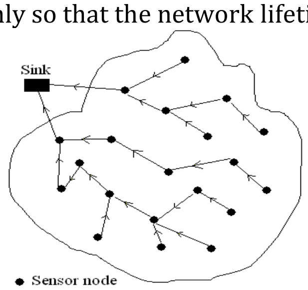

Fig 2: Multi Hop WSN.

Energy management and sensor deployment are two important and strongly related research topics in wireless sensor networks (WSN). The objective of energy management is to increase network operational lifetime through energy efficient protocols (Routing, MAC, etc.), while the main goal in sensor deployment on the other hand is to determine the location of the sensor nodes that minimizes the cost, provides high coverage and resilience to failures, and notably prevent energy hole. Due to the multi-hop sink-centric traffic in typical WSNs, the network often experiences unbalanced traffic distribution where sensor nodes act as data originators and relay nodes. Since the entire network traffic flows toward the sink, the nodes nearer to the sink will carry heavier traffic and will deplete their energy faster. This tends to create energy holes around the sink and partitioning the whole network, while the energy of the large majority of nodes remains unused. Uniformly exploiting the energy of all nodes is challenging in a multi-hop WSN, but also essential for maximizing the network service. Numerous works have been conducted for this purpose in the last few years. However, most of them rely on increasing the number of node around the sink to balance traffic which inevitably increases the cost of deployment [3].In large sensor network, the sensor nodes can be grouped into small clusters. Each cluster has a cluster head to coordinate the nodes in the cluster. Cluster structure can prolong the lifetime of the sensor network by making the cluster head aggregate data from the nodes in the cluster and send it to the base station. A randomly deployed sensor network requires a cluster formation protocol to partition the network into clusters. The cluster heads should also be selected. There are two approaches used in this process the leader first and the cluster first approach. In the leader first approach the cluster head is selected first and then cluster is formed. In the cluster first approach the cluster is formed first and then the cluster head is selected.

IV.Node deployment algorithms:

Research interest in sensor networks routing largely considers minimization of energy consumption as a major performance criterion to provide maximum sensors network lifetime. When considering energy conservation, routing protocols should also be designed to achieve fault tolerance in communications. Moreover, due to dynamic topology and random deployment, incorporating reliability into protocols for WSNs is very important. Hence, we propose an improved scalable clustering-based load balancing scheme (SCLB) in this paper. In SCLB scheme, scalability is achieved by dividing the network into overlapping multihop clusters each with its own cluster head node. Simulation results show that the proposed scheme achieves longer network lifetime with desirable reliability at the initial state compare with the existing multihop load balancing approach.

Power-Efficient Gathering in Sensor Information Systems (PEGASIS) protocol is energy efficient protocols designed to prolong the lifetime of the network by reduction of energy consumption. In this paper a modification is proposed to the PEGASIS algorithm where sensor nodes are clustered in groups, clustering is done by k-means algorithm, and each group is treated as PEGASIS. In addition the proposed algorithm used rechargeable sensor nodes. Two parameters are searched to select chain leader: Euclidean distance of sensor node to the base station and residual energy of sensor node. Each cluster head data is transmitted directly to the base station. Simulation results showed the proposed algorithms improved in comparison with original PEGASIS

Hybrid Energy-Efficient Distributed Clustering (HEED) that periodically selects cluster heads according to a hybrid of their residual energy and a secondary parameter, such as node proximity to its neighbours or node degree. In this approach, a probabilistic algorithm was employed to form a dominating set in a fixed number of rounds, with a penalty of slightly large dominating set size. This scheme builds a higher quality clusters than LEACH and PEGASIS that uses random selections and single chain, which results in a longer network lifetime.

In HEED, all cluster heads send aggregated data to the base station via the shortest path. This scheme minimizes the total energy consumption. However, the energy consumption is still unbalanced since neighbours of the base station are responsible to relay all packets to the base station and have higher load. A hot spot is formed in the area surrounding the base station, which is congested with data traffic and consumes energy much faster than other areas of the network.

A multilayer multi hop routing algorithm for inter cluster communication was presented by [8]. The algorithm worked on the principle of divide and conquers and performed better in terms of load balancing and energy efficiency than LEACH. The algorithm was aimed at exploiting the redundancy property of the WSNs. It selected a small percent of nodes from the network and marked them as temporary cluster heads and used these nodes to make the inter cluster communication multi hop. The problem with the algorithm was that it was selecting the temporary cluster heads randomly thus compromising occasionally on the area coverage of the network which it is monitoring.

V.Research Objective And Approach:

The main objective of this paper is to propose a algorithm which will minimize the traffic between nodes and sink. The coverage of nodes should be better by implementing the multi cluster algorithm with reliable communication. The communication between the nodes will take to the Cluster head, this head will communicate to the other set of the cluster group. The proposed algorithm will minimise the communication overhead between the cluster head in account of cost and energy management for static wireless sensor network.

This research work is load balance coverage of the nodes and deployment of the nodes for minimum hop paths with minimum traffic. By design the nodes with load balance technique which helps to regulate the energy consumption of the nodes and to increase network life time. Most of the energy of the node is dedicated in process of the data communication. In order to balance load between the node an improved Multi cluster algorithm that is hybrid of the existing inter cluster and intra-cluster routing approach. Scalability is achieved by dividing the network into overlapping multi-hop clusters each with its own cluster head node. Each cluster head is responsible for building a local relative map corresponding to its cluster using intra-cluster node's range measurements.

For increasing the life time of the node distributed dynamic load balancing is implemented in order to balance the load, saving energy and consequently increasing the network lifetime. These strategies can be more effective on event triggered WSN applications, avoiding that more than one node senses and processes the same event. This section revises two bio inspired techniques recently proposed for load balancing in event-triggered WSN.

VI. Conclusion:

After reviewing current work on sensor node deployment it is been observed that to gather streams of data in static Wireless sensor networks ,a novel node deployment algorithm should be proposed that generates minimum traffic sufficient for coverage. We need a technique which offers an excellent cost effective and energy-efficient solution for sensor node deployment which will make wireless sensor network to operate with prolonged lifetime.

VII.References

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