CLUSTER BASED ROUTING PROTOCOLS FOR DATA DISSEMINATION IN WIRELESS SENSOR NETWORKS: A SURVEY

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1. ABSTRACT

Wireless Sensor's are used significantly in areas where human monitoring is difficult to achieve acceptable results. Different wireless sensor units are used in diverse applications such as military, health care, disaster management, crop monitoring and other surveillance and monitoring systems. A large number of sensor nodes will be deployed to collect data and these sensor nodes communicate with each other by using wireless communication strategies that are administered by routing protocol. In this survey paper, we discuss the necessities and challenges of data dissemination in cluster based routing protocol. The survey elaborates and compares the cluster based routing protocols LEACH, EECS, HEED, TEEN and we outline the merits and limitations of these techniques and finally conclude the paper with the best method that can be used.

Index Terms: Wireless sensor network, routing, clustering, sensors, data dissemination.

2. INTRODUCTION

Wireless sensor networks (WSNs) have been exploited effectively and efficiently in areas like monitoring, traffic control, tracking, health care, automation and so on because of far-reaching consideration from the scientific society and engineering industry. WSNs have grow to be an essential part of various applications such as Medicine [1], environmental monitoring [1], armed forces supervision [2], and medicine [3] by providing feasible communication, reliable inspection, and performing applications. A large number of sensor nodes that are deployed densely over a large or small area of surveillance which communicate wirelessly form the wireless sensor networks. Each sensor deployed is called a node which is equipped with at least one or more sensing unit that senses an event and sends the sensed data by converting it into digital form by using a analog to digital convertor, a processor that controls the data and activity, power unit that supplies power to all parts of the sensor and trans-receivers for communication.

The number of nodes deployed in a surveillance environment ranges from few nodes to hundreds of nodes. Most of the sensor nodes that are deployed in a harsh environment remain unattended for quite a long period of time. In this period it in necessary to reconfigure the system parameters, fix the errors and update some of the software's in order to improve the system performance and to provide a reliable system. In WSN data dissemination is the process of routing data and queries to data in sensor network. Since it is physically impossible to manually collect and reconfigure the node, data dissemination over multiple hop networks is the best practice to collect data and send request to nodes.

Cluster based or hierarchy based techniques for data dissemination is a structured based scheme in which structure information is used to construct a dedicated disseminating structure. The structure information reduces the redundancy and does not affect the forwarding strategy. In cluster based approach, nodes are divided into clusters and a committed node is selected as cluster head. The cluster head collects the data and then disseminates data to its members in the own cluster.

3. LITERATURE SURVEY

[4] In this paper the authors has surveyed several hierarchical routing protocol which are developed based on LEACH routing protocol and has addressed its advantages and its issues in implementing. The descendants of LEACH approach is also highlighted in this paper.

Navjot Kaur, [5] has presented an enhanced LEACH protocol to overcome the problem of long life and minimum energy consumption by adding Cukoo Search (CS) and Support vector machine. Cukoo Search is used to select the cluster head and SVM is used to find the node with the highest energy. Authors have mentioned an energy saving up to 21.86%.

[6] In their work the authors have addressed the issue related to energy depletion due to mobility of sink node. The work is done to increase life time of network and to increase packet delivery to mobile sink. To select cluster head factors such as nodes residual energy, distance and data overhead is considered. According to the ouput obtained, it is stated that the algorithm outperforms the MOD-LEACH by 1.78 times in terms of lifetime.

Gandhi and the co authors in [7] have proposed a hybrid energy efficient protocol for routing in WSN. The protocol considers residual energy and node density as characteristic for selecting the cluster head. The protocol has been designed for heterogeneous network. Based on the type of nodes, different levels are defined for implementation.

[8] In this article the authors have suggested the TEEN protocol to improve energy efficiency in cognitive WSNs. Optimized TEEN method described in the paper increases the lifetime further operating in the same settings compared to regular TEEN. Vacant channels are used as weight in probability of each node in becoming the cluster head. The node that senses more idle channels will have the highest probability to be chosen as cluster head.

4. CLUSTER BASED ROUTING PROTOCOLS

CBRP is a hierarchical based routing protocol which aims at achieving energy efficiency by selecting the nodes with high energy to process and send data. That is high energy node is selected as cluster head, while nodes with low energy is used to sense and send data to cluster heads. The protocol based on clustering is classified as chain, block and grid depending on the clustering mechanism used.

LEACH is a Block Cluster Based (BCB) mechanism which has adopted distributed approach and does not ask for networks global information. Various modifications has been applied to LEACH protocol such as LEACH-TL [9], LEACH-M, LEACH – V, LEACH – C, W- LEACH and so on. The merits of using LEACH are i) each node gets an equal opportunity to become cluster head, ii) Unnecessary collision among the cluster heads is avoided due to use of TDMA. The limitations are i) cannot be used for large scale network due to single hop communication ii) uniform distribution of load is not guaranteed.

HEED is also BCB protocol that uses multi-hop clustering method to achieve energy efficiency. The cluster formation is based on two main considerations of the nodes i) nodes residual energy ii) intra- cluster communication cost. One of the main goals of HEED is to have even distribution of cluster heads in the network. The merits include i) routing is distributed and hence achieves load balancing ii) achieve scalability and energy benefits due to multi-hop communication. Limitations are i) energy consumption is unpredictable due to more CH, ii) overhead is more due to several epochs.

EECS is an effective clustering scheme for achieving energy efficiency in cluster based routing. This mechanism provides best acceptable results where periodical gathering of data is done in applications. It is similar to LEACH where single-hop communication is used between cluster head and base station. In EECS, CH nodes compete for the ability to elevate to CH for a given round [10, 11]. The sizing of the cluster is based on the distance of the cluster from the base station. Merits of EECS are i) dynamic sizing clusters ii) more balanced network in terms of communication and energy consumption. Demerits are i) consume lot of energy due to single hop communication ii) lot of overhead because of global communication.

The main goal of TEEN based routing approach is to cope with sudden changes in the sensed attributes. In TEEN , a 2-tier clustering topology is constructed with two threshold defined as soft and hard threshold. These thresholds define threshold values for sensed attributes and the small change in the value which triggers transmission. Cluster heads can send both type of threshold values where hard threshold reduces data communication by transmitting data only when the sensed value is in the range and soft threshold further reduces communication when there is little or no change in the sensed data. The advantages includes i) well suited for time critical applications ii) transmission is controlled based on thresholds which reduces the communication. Disadvantages are i) Difficult to decide the thresholds ii) communication fails if thresholds are not met.

GAF is a location based routing protocol that reduces energy consumed by the sensor nodes. It was first proposed for MANETs and later used in WSN also. The operation principal is based on the virtual grid in which network is divided into virtual zones called square grids. Each sensor in the grid operates in of the three modes Discovery, sleeping and active. In each grid, sensors can communicate with each sensor in neighbor grid. In each grid only one sensor is responsible for transmission of data while other sensors are in sleep mode. This benefits the prolonged network life. The merits are i) prolonged network life ii) routing commitment is maintained. Demerits are i) delay is not predictable.

CCS is a grid based protocol to reduce energy consumption loopholes in PEGASIS [12]. This protocol uses the location of base station to improve its performance. In CCS, the network is divided into concentric a circular track which forms the cluster and its level is assigned. The highest level is assigned to the cluster that is near to the base station. Chains are constructed in the tracks and one node is selected as cluster head. The merits are i) energy consumption is reduced ii) less data flow from BS. Demerits are i) large delay if chain is long.

5. CHALLENGES OF THE CLUSTER FORMATION

Forming the cluster and selecting the cluster head has to be done carefully since it affects the overall performance of the system. There are many challenges in selecting the nodes to form the cluster and then to select the cluster head among the nodes in the cluster.

The clustering algorithm used to form the clusters should take into account

Cluster Count: Most of the recent clustering techniques used probabilistic or randomized algorithms for cluster head selection which leads to different cluster counts.

Intra-cluster communication: base on single hop or multiple hop communication, the communication range in sensors is limited.

Overhead of cluster formation: The method used for forming clusters affects the overhead added to the network.

Balance: various parameters such as distance from BS, environment, number of members in the cluster and cluster head selection affect the load balancing the network.

6. CONCLUSION

The design of robust, scalable and energy efficient routing protocol in WSN is challenging task. To optimize energy consumption in WSNs and to increase network lifetime clustering methods are effective tools. In clustering methods, there are several considerations to select the cluster head. Which clustering protocol is ideal for an application depends on the type of network and the application in which it is used. In this paper, we have done an extensive survey of clustering protocols an d have found that based on the features of WSNs we have to choose different routing protocols to reduce the energy consumption of the sensor nodes.

7. REFERENCES

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