Dynamic clustering Approach in Wireless Sensor Networks

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Abstract— *Wireless Sensor Networks faces several practical challenges in terms of design and implementation. In Wireless Sensor Networks, Energy efficiency is a key design objective because the nodes are severely energy constrained due to battery powered. The Existing optimal randomized clustering protocol threshold value used to selecting the cluster heads in the network and also introduced a tree construction approach inside each cluster to minimize the energy consumption of the sensor nodes. As a result, it is evident that the cluster will-be overloaded with long range transmission to the remote base station, the extra processing is necessary for data aggregation, protocol co-ordination and the result of cluster head nodes expire before other nodes. To overcome this, a new dynamic clustering method is proposed, in which to maximize the network life time and reducing overloaded energy consumption. In the propose approach cluster-head selection is primarily determined by the residual energy level of each node, on the other hand, the ordinary nodes select which cluster to join according to the remaining energy level of the candidate cluster-heads and the parameter of communication cost in a cluster, so as to effectively achieve the load balanced distribution of energy loss in the network.*

Keywords—Data aggregation; Protocol co-ordination; Dynamic clustering; Energy Consumption;

I. INTRODUCTION

Wireless communication have enabled the deployment of large scale wireless sensor networks. A sensor network is an infrastructure comprised of sensing (measuring), computing, and communication elements that gives an administrator the ability to instrument, observe, and react to events and phenomena in the specified environment. From the environment surrounding the sensor and transform them into an electrical signal, processing of such signals reveals some specific properties about the objects or events happening in the vicinity of the sensor. The sensor stores sensed data and sends to a command center (base station) via radio transmitter either directly or through a data concentration center (gateway).

Basic features of sensor networks are limited power, short range broadcast communication, self-organizing capabilities, dynamic network topology, multi hop routing and large scale deployment. The limited energy in each node affects the lifetime of the entire network, and thus energy efficiency has been a critical design issue for the protocols and algorithms developed for WSN [1-2] the advantage of wireless sensor network lies in their flexibility and scalability. Cluster-based routing protocol is effective for prolonging the life time of WSN [3].

In cluster based routing, the nodes in the network take different roles according to a variety of conditions and metric. Each cluster has a leader referred to as cluster-head and other

ordinary member nodes. The cluster-heads can form another hierarchy among them. The clustering approach allows a WSN of high scalability, less consumed energy and thus longer lifetime for the whole network. This is mainly due to the fact that most of the sensing, data processing and communication activities can be performed within the clusters. However, energy consumption at a cluster head is significantly larger than that at other ordinary sensor nodes because cluster-head is responsible for delivering aggregated data in its cluster to the BS .This problem can be relieved by rotating the role of cluster-head among all nodes.

In this paper, proposed a dynamic clustering approach to improve network life time and reducing overloaded energy consumption in WSN,In the proposed approach cluster-head selection is primarily determined by the residual energy level of each node, on the other hand, the ordinary nodes select which cluster to join according to the remaining energy level of the candidate cluster-heads and the parameter of communication cost in a cluster, so as to effectively achieve the load balanced distribution of energy loss in the network.

II. CLUSTERING IN WIRELESS SENSOR NETWORK

A. Clustering Process

Clustering schemes consist of four stages: cluster head selection, cluster formation, data aggregation and data communication. Fig. 1 shows the clustering process of one round. In this figure the setup state starts by the cluster head selection stage and proceeds by constructing clusters. The setup state is followed by the data transmission state, which is subdivided into data aggregation and data transmission phases [4].

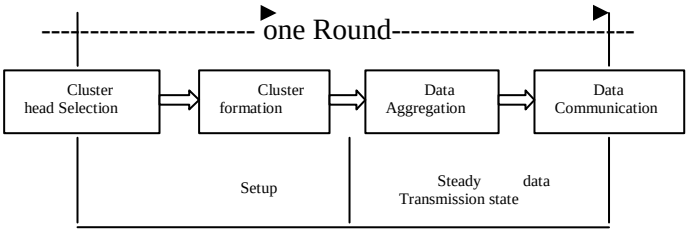

Figure1. The clustering Process of one Round

Clustering schemes/protocols have been used in sensor networks in order to achieve the following benefits.

- To balance the energy consumption among all the nodes.
- To eliminate the redundant and highly correlated data in aggregation process.
- To improve the overall network life span.
- To increase the scalability of the network.

B. Cluster Formation Phase

Cluster formation schemes are classified into homogeneous and heterogeneous clustering.

1. Homogeneous clustering (static clustering)

In homogeneous networks all the sensor nodes are identical in terms of battery energy and hardware complexity. With purely static clustering (cluster heads once elected, serve for the entire lifetime of the network)[4] in a homogeneous network, it is evident that the cluster head node will be over-loaded with the long range transmissions to the remote base station, and the extra processing necessary for data aggregation and protocol co-ordination. As a result the cluster head nodes expire before other nodes.

System Model

- All nodes are homogeneous and have the same capabilities.
- All sensor nodes are started with the same initial energy.
- When two communicating sensor nodes are not within each other's radio range, data are forwarded through other nodes.
- The BS has no energy constraint and is located far away from the target area.
- Data fusion or aggregation is used to reduce the number of messages in the network.

2. Heterogeneous Clustering (Dynamic clustering)

In heterogeneous sensor networks, the sensor nodes with different capabilities have been performing aggregation and transmission. The sensor nodes in the heterogeneous networks will have different levels of energy, memory, and resources. The main objective of the heterogeneous sensor network is to improve the lifetime and the reliability. Heterogeneous wireless sensor network performs well and provides reliable data.

Types of Resources

The following are the main resources of heterogeneous sensor nodes [7].

•Energy resource

•Computational resource

•Link resource

Energy Resource

The sensor nodes in the heterogeneous network may have line powered energy or the battery can be replaced. The sensor node will have more energy than the homogeneous sensor nodes. The lifetime of this sensor nodes are greater than the homogeneous nodes.

Computational Resource

The sensor nodes in the heterogeneous network will have a powerful micro controller and more memory than the homogeneous sensor nodes. The micro controller performs the computation faster than the homogeneous nodes. It also consumes more energy than the homogeneous nodes.

Link Resource

The sensor nodes in the heterogeneous network will have high bandwidth and the power transceiver than the homogeneous nodes. They also consume more energy than the homogeneous nodes. Since the computational resource and link resource consumes more energy, the energy resource is considered as the most important resource among them.

The following are some of the advantages of using heterogeneous sensor nodes.

•*Network lifetime* – energy consumptions is reduced in the heterogeneous networks. So the network lifetime can be improved

•*Throughput* – the data rate transmitted in the network will be more than the homogeneous network

•*Response time* – computational resource and link resources can reduced process time and waiting time

C. Data Aggregation Phase

Data aggregation is the process of aggregating the data from multiple sensors to eliminate redundant transmission and provide fused information to the base station. The main goal of

data aggregation algorithms is to gather and aggregate data in an energy efficient manner. Since sensor nodes are energy constrained, it is inefficient for all the

sensors to transmit the data directly to the base station. Data generated from neighboring sensors is often redundant and highly correlated. In addition, the amount of data generated in large sensor networks is usually large for the base station to process.

D. Data Communication Phase

In this phase, cluster heads as the coordinators of the cluster transmit the aggregated data to the base station for further processing by the end user according to the type of the application. The transmission of a packet from sensor nodes to the cluster head is called intra-cluster transmission and from cluster heads to the base station is called inter-cluster transmission. Intra cluster communication is further divided into single hop and multi hop transmission. Inter cluster communication is further divided into direct and multi hop transmission. In single hop transmission, all the sensor nodes in the respective cluster send sensed data to its respective cluster head directly [5]. Distance is not taken into account in single hop communication. In multi hop transmission all the sensor nodes of the cluster send sensed data to the nearest neighbor, which is on the way to cluster head [Yin2008] .In the direct communication cluster head, sends aggregated data to base station directly. Distance is not taken into account in direct communication. In the multi hopped communication all the cluster heads send aggregated data to the nearest neighbor cluster head, which comes in the way to base station.

III. PROPOSED APPROACH

A. Dynamic Clustering Approach (DCA)

DCA proposed formation of clusters depending upon the respective energy level of each node. It introduces the concept of assigning different energy levels to different nodes to balance the responsibility among the nodes with in a cluster. The node with the highest energy level looks for nodes within data aggregating node for that particular time interval. As soon as nodes forward the data to the cluster head they move to the wait state and remain in the sleep mode until they have something more to transfer. The proposed protocol helps in conserving energy by only allowing cluster head to communicate with other cluster heads. All other nodes except cluster head are in sleep wait so their energy is preserved. Indirectly as energy is preserved the lifetime of node is increased because lifetime of a node is defined as the time period till it is capable of transmitting data. The data when aggregated [6] at cluster head of each cluster is forwarded to the base station and the energy level of the cluster head is decremented. After a fixed interval of time the energy level of each node in a cluster is revaluated and compared with other nodes and the node having the highest energy is assigned to be the new cluster head of the cluster. This enables cluster formation even when energy and position of nodes is changing i.e. dynamic clustering. This leads to an effective utilization of energy of each node in the network. Only the nodes with highest energy levels are used for transmission and the energy of all the other nodes is conserved for future use.

IV. CONCLUSIONS

Clustering is a useful topology-management approach to reduce the energy consumption and exploit data aggregation in wireless sensor .In this paper focused DCA where clusters are refreshed periodically and cluster head is selected accordingly. The existing protocols support static clustering and cluster head is fixed in the entire scenario. Cluster head being used as the data aggregator node runs out of energy. So in this paper proposed a dynamic clustering Approach (DCA) that supports dynamic clustering with support of sleep and wait technology, where the node that needs to transmit the message is only in wake state after

forwarding the message the node changes the state to sleep. By this a lot of energy is conserved enhancing network lifetime indirectly.

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