

A Brief Review on Cluster Based Routing Protocol

Vartika Srivastava¹, Pallavi Gupta²

M.Tech Scholar, Department of Electronics and Communication, Babu Banarasi Das University, Lucknow, India¹

Assistant Professor, Department of Electronics and Communication, Babu Banarasi Das University, Lucknow, India²

Abstract: Recent developments in the field of Wireless Communication and Electronics have enabled the growth in application of Wireless sensor network such as health, military etc. Wireless Sensor Networks comprise of large number of sensor nodes which are tiny and low cost. Sensor nodes have dual functionality of being both data originator and router. It communicate together by various wireless strategies which are regulated by routing protocols. The efficiency of sensor network depend on the routing protocol. In wireless sensor network, routing protocol have three main categories 1) Flat routing 2) cluster based routing 3) Location based routing. This paper shows the survey on cluster based routing protocol in wireless sensor network. In this paper, we focus on the classification of cluster based routing protocol. Finally, we conclude the paper with some future direction.

Keyword: Wireless Sensor Network; Classification; Routing protocol; Cluster based routing protocol.

I. INTRODUCTION

Wireless Sensor Network is an infrastructure less network i.e.; routing and resource management are done in a distributed manner. The Wireless Sensor Network is composed of tiny sensor nodes. This sensor can sense and gather information from the environment and it transmit the information to the user. Sensor nodes have confined energy and are deployed in difficult conditions to access location [1]. Figure 1 Shows below how the sensor nodes are deployed in the sensor field and Figure 2. Shows below the component of sensor node. Each of these scattered sensor nodes has the ability to gather information and communicate either among each other or transmit the information from sink to the user [2]. The components of sensor nodes are sensing unit, processing unit, transmitting unit, power unit. Because of the limited power supply, transmission, processing capability and efficient routing becomes an important issue in Wireless Sensor Network. Routing protocols in wireless sensor network give emphasis on the energy efficient routing, in order to make effective and reliable communication [3].

WSNs. In section 4, compare the types of cluster based routing protocol. Finally, In section 5, we conclude the paper.

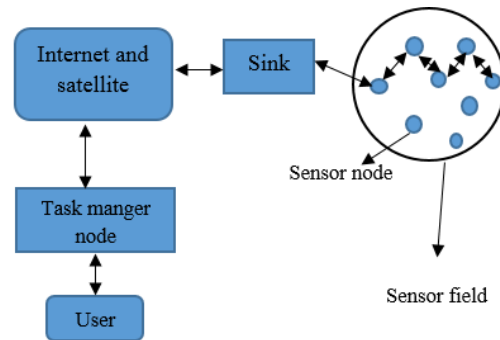


Figure 1: Sensor node deployed in sensor field

Routing protocol in wireless sensor networks can be classified into three categories: Flat routing, Cluster based routing, Location based routing. In Flat routing protocol, each and every sensor node plays the same role and nodes collaborate together to sense the environment. In cluster based routing protocol, it is also called as hierarchical routing. It has two routing approaches i.e.; First one is to select the cluster heads and other one is used for routing. In Location based routing protocol, It is used to estimate the distance between neighboring nodes so that energy consumption can be calculated [4, 5]. In section 2, challenges of routing protocol in wireless sensor networks are covered. In section 3, a classification and comprehensive survey of cluster based routing protocol in

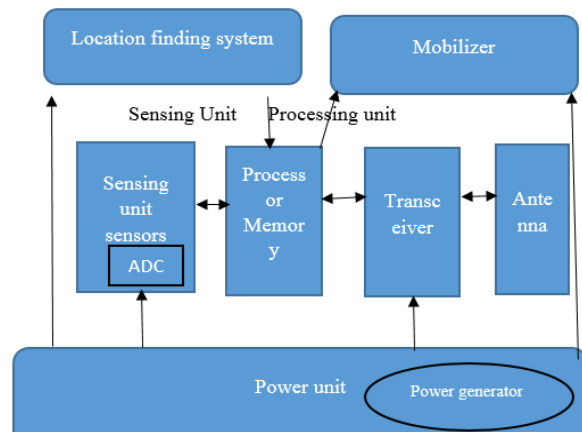


Figure 2: Key component of sensor node

II. CHALLENGES OF ROUTING PROTOCOL IN WIRELESS SENSOR NETWORKS

In wireless sensor network, sensor nodes transmit information over wireless, lossy lines with no infrastructure. Sensor network have several restriction such as limited energy, computing power and bandwidth of the wireless links which are connected to the sensor nodes [6]. We discuss some of the challenges and design issues that affect the routing process in wireless sensor networks [5,6,7].

2.1) Deployment of node: It is application dependent and it also affects the performance of routing protocols. In this case nodes deplete energy in exchanging the information through the wireless medium which increases the overhead of the protocol.

2.2) Power consumption without affecting accuracy: The main objective is to deliver the data efficiently without compromising the accuracy of the information content.

2.3) Transmission media: In a multihop sensor network, communicating nodes are linked by a wireless medium. These links can be formed by optical, infrared, radio links. The medium is affected by fading, high error rate and it also affect the function of wireless sensor networks.

2.4) Scalability: Wireless sensor network consist of a large number of nodes (in the order of thousands or more). Sensor network routing protocols must be scalable to respond to events in the sensing environment.

2.5) Fault Tolerance: Some sensor node may be blocked or fail because of a physical damage, software problem, environmental interference or by exhausting their energy supply. The failure of node result disconnection from the network. Fault tolerance is the ability of the network to sustain functionality without any interruption due to node failure.

III. CLASSIFICATION AND COMPREHENSIVE SURVEY OF CLUSTER BASED ROUTING PROTOCOL IN WSNs

Cluster Based Routing Protocol has a higher energy nodes that can be process and send the data. On the other hand, lower energy sensor nodes can be used to perform the sensing in the proximity of the target area [3,8].

The main goal is to efficiently maintain the energy consumption of sensor nodes. Therefore, it has three broad categories such as block cluster based, grid cluster based, chain cluster based routing protocols [9].

1) BLOCK CLUSTER BASED ROUTING PROTOCOLS:

They are classified as LEACH, LEATCH, HEED, TEEN, EECS and UCS.

1.1) LEACH Protocol:

It stands for Low Energy Adaptive Clustering Hierarchy Protocol. It uses single hop routing where it forms clusters which depends on the strength of the received signal and

also uses the cluster heads as gateway to the sink. This will preserve power when transmission will be done by cluster heads rather than sensor nodes. It includes distributed clustering establishment [3, 8, 10].

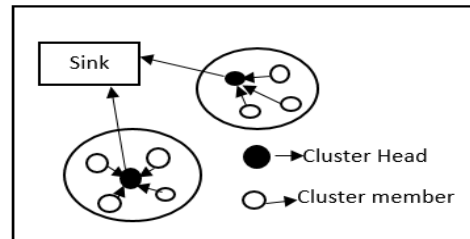


Figure 3: LEACH Clustering Model

1.2) LEATCH Protocol:

It stands for Low Energy Adaptive Tier Clustering Hierarchy. It is advance version of LEACH. LEATCH gives better performance in terms of delay, throughput, and energy consumption because of using gateway nodes in between the cluster-head nodes and the sink with balancing clustering technique. It extending the probability of any node to be covered by a cluster head or mini cluster head [10].

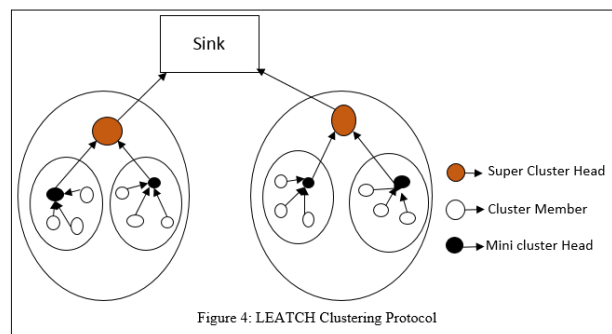


Figure 4: LEATCH Clustering Protocol

1.3) HEED Protocol:

It stands for Hybrid Energy Efficient distributed Protocol. It uses multihop routing. It is a fully distributed routing approach. HEED was designed to select different cluster heads in a field according to the amount of energy that is distributed in relation to a neighboring node. It is energy efficient clustering which makes two parameters 1) Node residual energy 2) Intra communication [11].

1.4) TEEN Protocol:

It stands for Threshold Sensitive Energy Efficient Sensor Network. It is well suited for time critical application such as intrusion and explosion detection. Information transmission use up more power than data sensing. In this scheme, the energy consumption is less than a proactive networks as data transmission is done less frequently [3, 8, 12].

1.5) EECS Protocol:

It stands for Energy Efficient Clustering Scheme. It is a self-directed and energy efficient and it also increase the

network lifetime. It perform periodical data gathering application using single hop wireless sensor network. The network is divided into a set of cluster with a single cluster head in each clusters. In this communication between cluster head and sink is done by single hop sensor network [13].

1.6) UCS Protocol: It stands for Unequal Clustering Size. It is used to balance the energy consumption of cluster heads due to heavy inter cluster relay traffic. In this, information can be transmitted through multihops. It is not suitable for large range network [14].

2) GRID CLUSTER BASED ROUTING PROTOCOL: They are classified as GAF, TTDD, PANEL, SLGC etc.

2.1) GAF Protocol: It stands for Geographical Adaptive Fidelity. It can increase the lifetime of the sensor network by conserving energy. It is not suitable for real time applications in wireless sensor networks. It is completely static and localized [15, 16].

2.2) TTDD Protocol: It stands for Two Tier Data Dissemination. It efficiently gives information delivery to several mobile links. Each and every sensor node is aware of its own location through GPS, TTDD's design uses a grid structure that's why only sensors placed at grid points need to acquire the transmitted data. It has low power efficiency [16, 17].

2.3) SLGC Protocol: In this protocol, usage of energy is minimum. It gives better efficiency [16, 18].

2.4) PANEL Protocol: It stands for Position-Based Aggregator Node Election Protocol. It supports asynchronous applications. PANEL uses the geographical information of the sensor nodes to resolve that which of them should be the aggregator. It is an energy saving method that gives surety to prolong

network and also load balancing because of each node convert into a cluster head with equal possibility [19].

3) CHAIN CLUSTER BASED ROUTING PROTOCOL: They are classified as PEGASIS, CCM, Grid PEGASIS, and PCCR etc.

3.1) PEGASIS: It stands for Power Efficient Gathering in Sensor Information System Protocol. It increases the lifetime of network. Sensor nodes first communicate with their nearest neighbors and then turns to the sink. It allow local coordination between sensor nodes which are close together that's why the bandwidth consumed in communication is reduced [9, 20].

3.2) CCM: It stands for Chain Cluster Based Mixed Routing Protocol. It can overcome the power consumption by uniformly deploying sensor nodes. However, it ignore the power consumption coming by long distance between chains and also the delay which is coming from long link. It reduces data flow from sink [20].

3.3) PCCR: It stands for Position Based Chain Cluster Routing. It is developed for narrow strip area application where the routing cannot applied. In this, area is divided into belt-shape region cluster where every region selects a cluster head which depends on the position and residual energy [20].

3.4) GRID-PEGASIS: It is advance version of PEGASIS which is based on energy efficiency and balancing. It has three types of topology such as 1) Random Deployment 2) Intra Grid random 3) Deterministic topology. In Deterministic topology, the sensor nodes will deployed in predetermine area. In Intra Grid random, sensing area will divided into grids. In Random Deployment, sensor nodes are randomly deployed in the each grid [20].

IV. COMPARISION BETWEEN ROUTING PROTOCOL

Comparative study on cluster based routing protocols:

| Name | Scalability | Delivery Delay | Load Balancing | Algorithm complexity | Energy Efficiency |
|--------|-------------|----------------|----------------|----------------------|-------------------|
| LEACH | Very low | Very small | Medium | Low | Very low |
| LEATCH | Medium | Small | Good | Low | Medium |
| HEED | Medium | Medium | Medium | Medium | Medium |
| TEEN | Low | Small | Good | High | Very high |
| EECS | Low | Small | Medium | Very high | Medium |
| UCS | Low | Small | Poor | Medium | Very low |
| GAF | High | Very small | Medium | Medium | Medium |
| TTDD | Low | Very large | Good | Low | Very low |
| PANEL | Medium | Medium | Good | Low | High |

| | | | | | |
|--------------|----------|------------|--------|--------|----------|
| SLGC | Very low | Very small | Medium | Medium | Medium |
| PEGASIS | Very low | Very large | Medium | High | Low |
| CCM | Very low | Small | Medium | Medium | Very low |
| GRID PEGASIS | Medium | Medium | Good | Medium | Medium |
| PCCR | Medium | Low | Medium | High | Low |

V. CONCLUSION

One of the important type in Wireless Sensor Networks is Cluster Based Routing Protocol that can reduce the energy consumption and extend the lifetime of the network. In this paper different type of the Cluster Based Routing Protocols are briefly described.

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