ISSN: 2456 – 3137
International Journal of Computational Research and Development
Impact Factor 5.015, Special Issue, February 2019 - Conference Proceedings
International Conference on Management 4.0: Disruptions in Business and Millennials at the Workplace (KRUPACON 2018) On 12th & 13th October 2018 Organized By
Krupanidhi Group of Institutions, Bangalore, Karnataka

A BRIEF SURVEY ON HIERARCHICAL ROUTING PROTOCOLS IN WSN

Rajkumar N* & N Anuradha**
* Krupanidhi Group of Institutions, Bangalore, Karnataka
** Krupanidhi Degree College, Bangalore, Karnataka

Cite This Article: Rajkumar N & N Anuradha, "A Brief Survey on Hierarchical Routing Protocols in WSN", International Journal of Computational Research and Development, Special Issue, February, Page Number 4-7, 2019.

Abstract:

A WSN has a large range of lightweight, low-power sensors that detect the environment, process data and communicate between wireless components. This paper shows several protocols for routing which expand the range of nodes by comparing different approaches. It reflects on the low power battery and bandwidth limitations, which concentrate the network's productive operation.

Key Words: WSN, Clustering, Network Lifetime, Routing Techniques.

Introduction:

This organization would have countless tiny sensor knobs that see knowledge sinking. Clusters are commonly sought to achieve network stability. There are two groups of nodes in a network, the sensor nodes and the second cluster head node. Any small energy sensor node has its own sensing abilities, whereas a base station is far from the sensory node region [1], also known as a drain. These nodes experience a continuous change in the world and send mutual data to BS. The classification of different nodes is a phenomenon of the aggregation of nodes such that only condensed data can be passed to the BS. CH gathered the data and forwarded it to BS instead of any node sensing and sending its own data. Figure 1 demonstrates the clustering hierarchy of WSN.

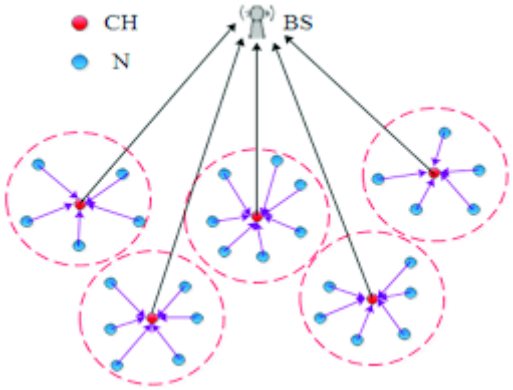

Figure 1: Clustering Hierarchy of WSN

The picture needed for selecting CH contains [1], computerization and initialization, limitations required to select the position of various detection stations, improvisation required to select the cluster head carefully, or cluster head selected as a result are uniformly scattered or not.

Although WSN is frequently used in many applications, [2] it has some drawbacks:

- Constrained Energy
- Position of nodes
- Large and random arrangement of nodes
- Network unpredictability
- Prone to breakdowns

These considerations enable routing methods to be developed. These techniques are aimed mainly at improving the presence of nodes to allow them to do the least work in sending out data, as after their battery dies nodes become inefficient, which leads to an increasing life expectancy for the whole network [3].

Energy Efficient Routing Protocols:

A network can be categorized on the basis of the structure into a Positional, Hierarchical and Flat Network. A protocol exchanges knowledge in a flat network as and when appropriate, and searches for the efficient route per node. Nodes are graded as low energy and energy dense nodes in the hierarchical protocol. Bad energy knots are used for sensing purposes and strong knots for information processing. It is generally agreed that hierarchical routing protocols of all classifications are additionally economical and provide additional versatility in handling the routing details. It is therefore commonly used in WSN [4]. Few hierarchical routing protocols with energy efficiency are:

A. Low Energy Adaptive Clustering Hierarchical (LEACH):

It is the most general, self-adapting, and self organizing energy-efficient stratified routing protocol which are used to minimize energy consumption while increasing the length of the network to some degree [5]. LEACH is mainly divided into two stages, namely the implementation part, wherever cluster heads are chosen and the state part is stable where CH is retained until information is passed from the nodes to CH [6]. The state's permanent component is far expanded to lower trivial energy prices than the defined part [2]. The option of CH is based on the price threshold, T(n). The node is arbitrarily elective between zero and

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one and evaluations it with T when the cluster is formed (n). If the varying amount you chose is below this threshold, Chosen as CH or it becomes a node for this round. CH continues to align the energy quality of detector nodes with complex haphazard [7].

$$T(n) = \left(\frac{p}{1 - p * rmod\left(\frac{1}{p}\right)} \right) if\ n \in G$$

T(n) is 0 Otherwise
p is the percentage of CH nodes among all nodes.
G is number of remaining nodes that are not elected as CH in the first 1/p rounds.
r represents count of rounds.
PEGASIS, TEEN, APTEEN are suggested as routing protocols apart from LEACH that concentrate on energy conservation and thus improve the life expectancy of the whole network.

B. LEACH-C (Centralized):

LEACH-C is an increase of the stable state LEACH uses as LEACH [8]. Knots whose energy is less than that amount are not authorized to become CH. BS guarantees the work is equally divided among all other nodes [9] in order to evaluate the best clusters. The advantage of such protocol style is that the total number of CHs is reported by BS, and then the network is broken down into clusters, minimizing the energy necessary for non member CHs to transmit the data needed to their corresponding CH. The LEACHC clusters are organized centrally by the necessary BS. This does not, however, mean that there are healthy nodes within each cluster.

C. Base station Controlled Dynamic Clustering Protocol:

BCDCP does the same job as in the case of Leach-C to delegate complicated equations to BS. The LEACH protocol uses the same initialization process as well as the data communication phase. A member group of CH nodes is elected by the BS for the creation of a cluster. It uses slicing algorithms for partitioning purposes to match the number of cluster head nodes. The BS CH sends the collective data through the BS on the basis of a multi-shop without direct contact. The LEACH-C protocol uses the same method of transmission.

D. Power- Efficient Gather In Sensor Information System (PEGASIS):

PEGASIS arranges nodes in a chain manner, which is one node, while the BS-related other and final node [9]. The benefit of PEGASIS is to decrease information input calculation from contiguous nodes when detector-collected information travels from the original node to the consecutive node and passes the information it receives to the final terminal. This inhibits transfer and receipt between nodes. Though it suffers from:

- First, BS is a special leader, who can contribute to a problem of bottleneck.
- The distant node on the chain triggers an immoderate disruption.

The solution to this problem is Hierarchical PEGASIS whose aim is to diminish the delay induced by the simultaneous transition between adjacent nodes in contact with the BS. This could cause collisions that can be solved either by the inclusion of signal coding or the simultaneous transmission of data through widely spaced nodes.

E. Concentric Clustering Scheme (CCS):

The PEGASIS [10] protocol mentioned above uses CCS to minimize energy consumption. The network here is divided into circular paths and each path is a cluster. The level is assigned for each track. Stage 1, the proximal direction to the BS, and level rises as it travels away from the base station. Compared to PEGASIS, the benefit of this protocol lies in decreasing the distance from the lead node from which data must be transmitted to the BS, which is thereby leading to a substantial energy reduction. The opposite flow of BS data is reduced as the network is split into a variety of concentrated clusters, which is sensible for PEGASIS.

F. Threshold- Sensitive Energy Efficient Protocol (TEEN):

TEEN operates on the soft and hard thresholds with two thresholds [9]. The consumer will alter these thresholds to modify packet volumes. The TEEN results suggest that it reaches LEACH. A CH drives the neighbors with a hard and soft threshold. At the soft threshold, the value of the sensing attribute may be altered in the small sum, whereas the nodes are distributed at the hard threshold only when the detected attribute helps to minimize the contact amounts. Transmission is done only if the following conditions are met:

- Conceived value > Hard Threshold
- Conceived value~ Hard Threshold >= Soft Threshold

G. Adaptive Threshold Sensitive Energy Efficient Protocol (APTEEN):

There is a corresponding spike in teens and uses the same style. It is intended for sudden changes in associated conditions, especially in terms of temperature, to be reciprocated. It is capable of reacting to time-constrained jobs, gathering information at frequent intervals [11] and thus outperforming young people. APTEEN operates on three forms of consumer requests [12]:

- History query: This query is useful for evaluating data collected at BS from historical and actual data.
- One-time query: The query offers a network image view, such as the temperature.
- Persistent query: The query tracks the network for certain criteria for a long time.

To build a hybrid network, APTEEN uses modified TDMA schedules. APTEEN operates like this; node-sensing environments will continuously feel data above their hard threshold, afterwards they will forward data when the value of a function increases by

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a value that is greater or equal to a soft threshold. When the node does not send data for a time equal to the number of days, it is mandatory after it is sensed to retransmit data.

H. Energy Efficient Clustering Scheme (EECS):

The big advantage is that this provides versatility because it allows consumers to control energy usage levels and count times. Results of the simulation reveal that APTEEN lies in the energy dissipation and the network time among LEACH and teen. The three-tier architecture is used to organize sensor nodes into clusters prior to the network's operation [13]. This protocol uses cluster headers, that is, doorways that as compared with sensors have relatively low power constraints and are presumption to have sensor node data of a location. Gateway aims to preserve sensor states and establish multiple hopping routes to aggregate sensed data. The nodes are used to deliver data passages for TDMA-based MAC scheduling. The sensor is supposed to be expert in this protocol, to operate in an active state or at a low power stand. This protocol, along with sensing and managing circuits, permits the freedom of transmitters and receivers. The sensor nodes in a cluster may be: sense, relay, sensory relay and eventually inactive.

- The node senses the atmosphere at sensing condition and outputs data on a fixed rate.
- In relay mode, the node cannot feel even though it has an active contact circuit to transfer data from other active nodes.
- It is assumed that the node is cable of both at a sensing dependent state; otherwise node is assumed to be inactive.

Cost function between two random nodes can be defined on the basis of energy consumption. The least cost path between gateway and sensor nodes can therefore be determined. Each sensor involved in the sensing, sorting, forwarding and relaying processes is continuously controlled by the gateway [7].

I. Hybrid Energy-Efficient Distributed Clustering (HEED):

The aim of this protocol is to choose an effective head of a cluster based on the physical distance criterion that lies between two nudes.

Main Aim of This Type of Protocols:

- Extend the life expectancy of the network by fair share of electricity.
- Minimum usage of energy during the selection of the cluster leader.
- Overhead reduction in the network.

The cluster head collection takes two things as a starting point:

- Residual energy in each node helps to pick initial cluster head classes.
- For deciding which cluster to join, Node uses Intra-Cluster Communication Cost. This is sufficient for a case in which a certain sensor is more than one CH within the coverage area.
- It is important, since each node has more than one power level, to know the power level associated with that node. The power level used by the nodes corresponds to the cluster power level when intra-cluster announcements and clustering. High cluster power levels are taken into consideration for inter-cluster propagation, while low cluster power facilitates spatial regeneration. The primary objective of this protocol is to select those clusters which achieve the lowest transmission cost between the node and the CH within the cluster.

J. Self-Organizing Protocol (SOP):

Sensor nodes may be stationary or mobile in this type of protocol. Sensors scan the area and send the data to the named group of routers. These routers are stationary unlike sensor nudges and form the base for contact. Added information is then sent to the base stations via the routers (BS). The algorithm is based on the following phases to self-organize router nodes and to build respective routing tables [13]:

- Discovery Phase: Node is discovered during this phase only directly to the sensors.
- Organization Phase: aggregation by creating a hierarchical system is carried out and consolidated.
- Maintenance Phase: routing tables are modified so that energy levels are established for nodes.
- For broadcasting use [14], LML (local Markov loops) algorithm is used.

K. Energy-Balanced Chain-Cluster Routing Protocol (EBCRP):

The chain cluster topology is the basis of this protocol. Here each sensor node transmits equivalent quantities of data, and between many nodes, small distances are delivered. New sensor nodes communicate exclusion to CHs to each other.

L. Chain-Based Hierarchical Routing Protocol (CHIRON):

In order to minimize power dispersion for distance transfers, CHIRON uses short payload and multi-hop data transmission [10]. The length of the chain and the transmission routes can be accurately shortened, thereby decreasing the time for transmission. The biggest drawback is that multiple areas isolated by this protocol do not even contribute to asymmetry and delay in power usage.

M. Energy-Aware Data Aggregation Tree (EADAT):

It addresses the energy dilemma and concentrates energy-conscious data-centered routing. The EADAT benefit is that high-performance sensor nodes are often chosen as leafless, and can carefully track the load. The route selection is mainly considered for the rest of the power and distance [15]. This protocol often uses more control.

N. Balanced Aggregation Tree Routing (BATR):

BS is supported with GPS localization and routing of each node in advance.

O. Power-Efficient Data Gathering and Aggregation Protocol (PEDAP):

This is a tree-based tree, a protocol used to maximize the lifespan of the network, defined according to the amount of transmission. For data exchange, it uses a low energy cost tree.

P. Enhanced Tree Routing (ETR):

This attempts to exchange costs and results. The principle of this protocol is that each node would have a modern neighboring table with the address of its next neighbors [15]. This table is used to distinguish different routes to the BS with the hops fewer than the current one.

Conclusion:

This paper presents the brief review of WSN hierarchical routing protocols. Energy is a major constraint in the smooth functioning of networks. Routing protocols have to be energy sensitive in order for each sensor and thus the network's life expectancy to be improved. This survey document reveals different protocols based on hierarchy that has their own benefits and drawbacks. Due to inadequacy and difficulty in protocol routing, further work is required to build a more efficient, flexible and robust energy clustering framework.

Acknowledgement:

The authors express gratitude towards the assistance provided by The Management, Krupanidhi Group of Institutions (KGI) and Krupanidhi Research Incubation Centre, KGI in completing the research. We also thank our Research Mentors who guided us throughout the research and helped us in achieving the desired results.

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