Clustering Protocols for Energy Efficient in Wireless Sensor Networks using Adaptive Harmony Search Algorithm

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Abstract - *Wireless sensor networks consist of small battery powered devices with limited energy resources. Once deployed, the small sensor nodes are usually inaccessible to the user, and thus replacement of the energy source is not feasible. In wireless sensor networks, optimization is one of the major concerns. It degrades the performance of the network. So, it may lead many challenges such as energy constraints, limited bandwidth and computing capabilities. Clusters create hierarchical WSNs which incorporate efficient utilization of limited resources of sensor nodes and thus extends network lifetime. This survey provides efficient clustering methods in WSN.*

Index terms: *Bandwidth, Clustering WSN (Wireless sensor Networks).*

I. INTRODUCTION

A Wireless Sensor Network (WSN) consists of hundreds or thousands of sensor nodes or motes equipped with various sensing devices to observe events in the real world. Sensor nodes usually communicate among themselves using wireless only. Also they are usually powered by battery, and therefore have limited energy. Besides each sensor node has limited computation power and memory again due to constraints imposed by the available supply of energy.

The major function of WSNs is to observe and record events in the environment and report them to the sink if necessary. In the process, the sink node may also need to broadcast messages to each node of the WSN, and sensor nodes may need to communicate with each other as well.

Wireless sensor network are usually deployed, possibly in extreme conditions such as mountainous region, and left unattended to function for long time. In order to prolong the network lifetime, it is necessary to minimize the consumption of energy by individual nodes. In addition, it is also necessary to ensure that the average rate of consumption of energy by each node is also the same. This would ensure that the connectivity needed to transmit data from a sensor node to sink can always be maintained. A third requirement of WSNs for applications such as tracking of intruders, detection of fire etc. is that the delay to transmit data from sensor node to the sink should be as minimum as possible. These are complex set of requirements which a routing protocol for wireless sensor networks needs to fulfill.

In many wireless sensor network applications source nodes generate and send periodic traffic to a sink node through a number of intermediate nodes. Nodes have usually only a limited amount of energy and thus achieving a long node lifetime is a major research concern. One of the key approaches to achieve this is to let the forwarding nodes switch to an energy-conserving sleep state whenever possible. In this sleep state parts of the node hardware, especially the wireless transceiver, are switched off. This disables the communication ability of a node but leads to significant energy savings, since for most of the currently available sensor node platforms the wireless transceiver is the dominant source of energy consumption. The fraction of time where the node is awake is called its *duty cycle*, and from the perspective of energy-efficiency this duty cycle should be kept small. For a source node generating the periodic data there is no problem: the node wakes up, samples its sensor, transmits a packet and returns to sleep mode. However, in a multi-hop network other nodes are needed to forward the packet to a sink node. To be most energy-efficient, a forwarder should wake up just before a periodic packet arrives, do the necessary forwarding work and enter sleep mode again. However, in general the time difference between packets (the jitter) seen by a forwarder is not ideally regular, but has a random components, for example due to the usage of randomized MAC protocols or time varying cross-traffic (resulting in queuing effects).

The sensor network model depicted in Fig. 1 and consisting of one sink node (or base station) and a (large) number of sensor nodes deployed over a large geographic area (sensing field). Data are transferred from sensor nodes to the sink through a multi-hop communication paradigm.

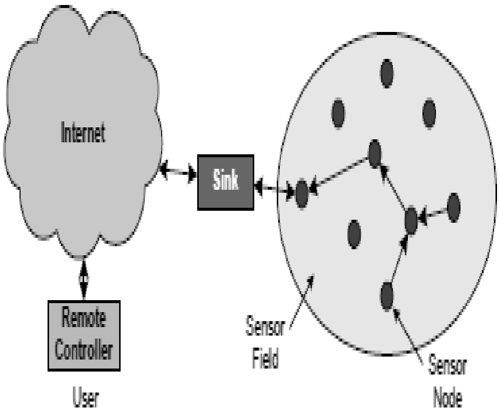

Fig 1: Sensor Network Architecture

II. RELATED WORK

A. BCDCP

Base-Station Controlled Dynamic Clustering Protocol [4]: In this protocol used to distribute the energy dissipation equally between all sensor nodes to improve network lifetime and average energy saving. The major components of the protocol are mentioned in Fig 2.

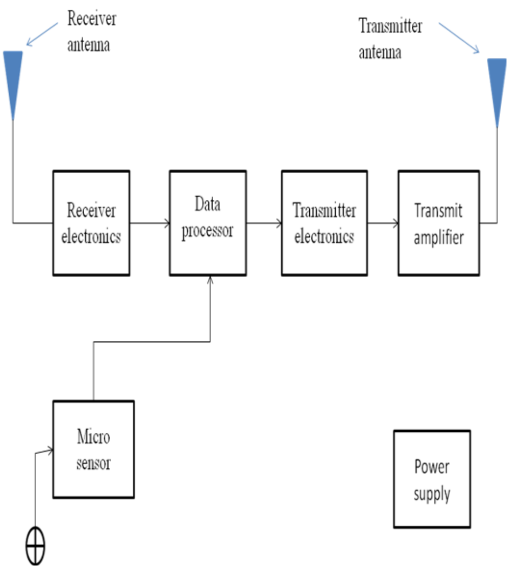

Fig 2: Basic Architecture of BCDCP

The performance of BCDCP is then compared to clustering-based schemes such as Low-Energy Adaptive Clustering Hierarchy, LEACH centralized, and Power-Efficient Gathering in Sensor Information Systems. It improves the network lifetime and energy consumption using this protocol.

B. REACA

Robust Energy Aware Clustering Algorithm [6]: In this algorithm randomly selected the few sensor nodes as cluster heads then they distribute the load among the nodes in entire network. In here selection of master node with most energy for producing the best performance in the network. The Fig 3 represents general architecture and the Fig 4 shows the time cycle of protocol operation.

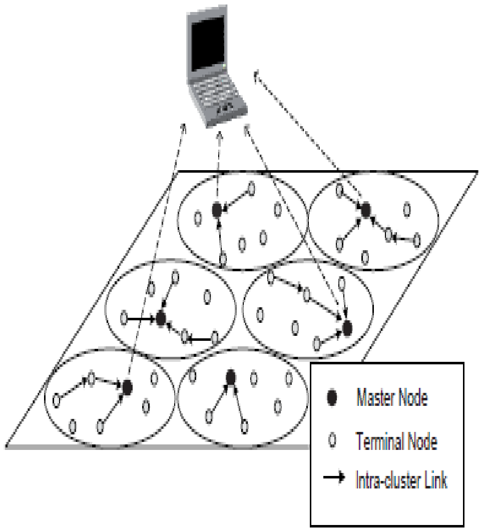

Fig 3: A Generic model of REACA Networks

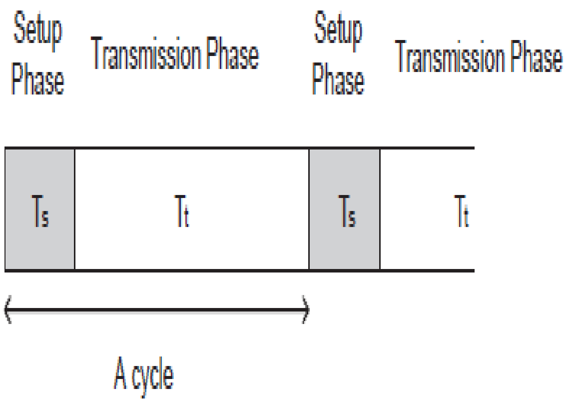

Fig 4: Protocol Operation in One Time Cycle

The advantage of this method is bandwidth and energy can be utilizing efficiently.

C. THCHP

Two-level Hierarchical Clustering based Hybrid-routing Protocol [8]: In this protocol used to minimize the time delay when compare to Adaptive Periodic Threshold-sensitive Energy Efficient sensor Network. The Basic architecture for this protocol is mentioned in Fig 5.

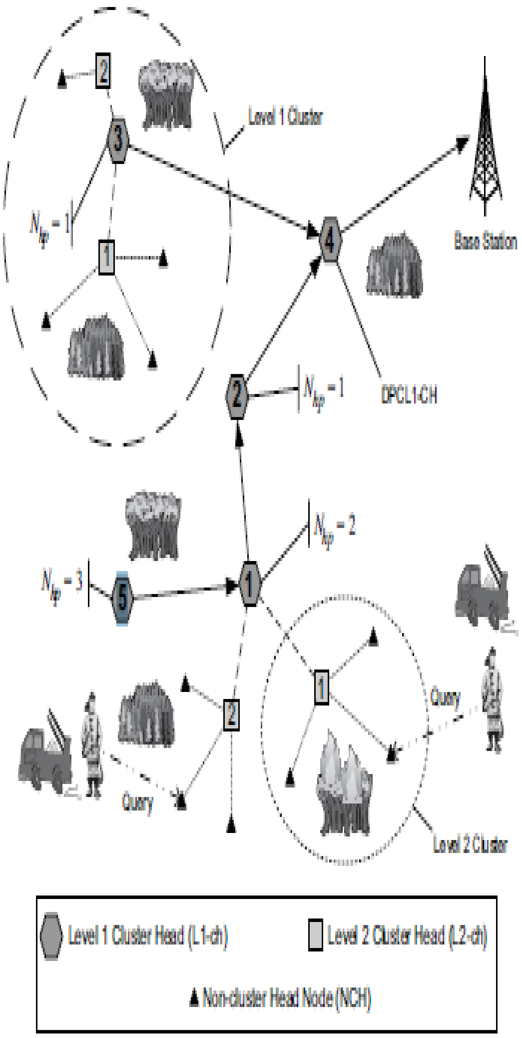

Fig 5: Basic Architecture of THCHP

The working method of this protocol is it divided the data into frame sequences. The structure of data frame is mentioned in Fig 6.

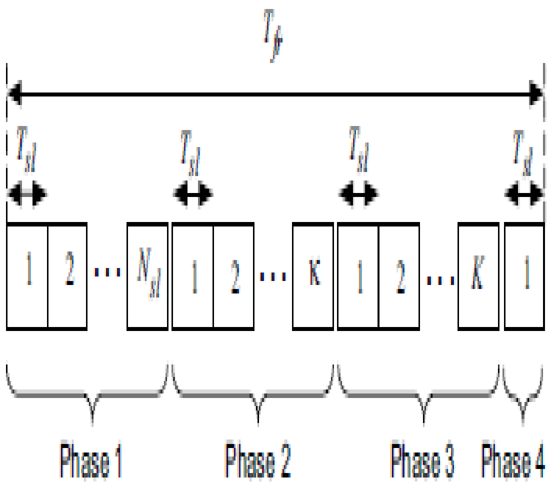

Fig 6: Data Frame Structure of THCHP

The main advantage of this method it must be suitable for delay sensitive application in WSN.

D. O-LEACH

Optical- Low Energy Adaptive Clustering Hierarchy[9]: LEACH is a hierarchical protocol in which most nodes transmit to cluster heads, and the cluster heads aggregate and compress the data and forward it to the base station. Each node uses a stochastic algorithm at each round to determine whether it will become a cluster head in this round. LEACH assumes that each node has a radio powerful enough to directly reach the base station or the nearest cluster head, but that using this radio at full power all the time would waste energy.

Setup phase

In this protocol same as to leach protocol but two major differences in here. WSN nodes cannot deployed the DFS coverage area. Nodes in coverage area then it regenerate a round node otherwise it will select the cluster heads

Steady phase

It supports only the cluster head with in the same WSN field. Steady phase is same to LEACH. The flowchart for O-LEACH network is mentioned in Fig 7

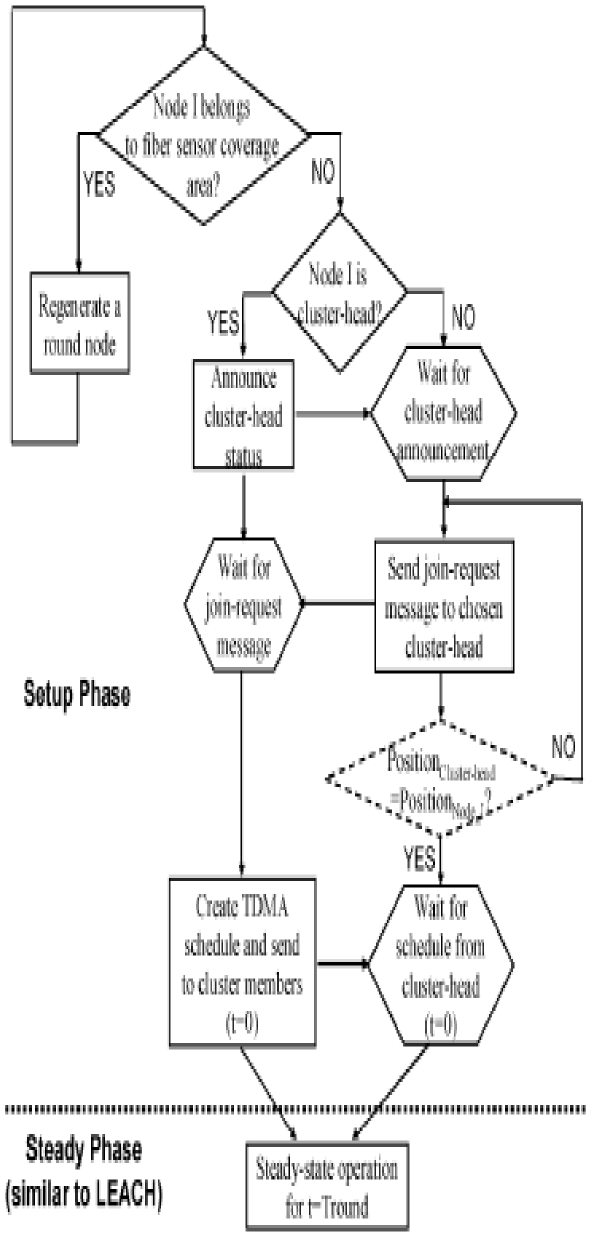

Fig 7: Flowchart for O-LEACH Method

This method is used to improve the overall lifetime of the network.

E. IHS

Improved harmony search algorithm [10]: It is the musical improvisation process the musician to polish the pitch in order to search the better harmony. These algorithms initially set the initialization parameter of problem and algorithm optimization of harmony memory and pitch adjustment. Its finding the new harmony with better optimization. This algorithm produce the best results when compare to other algorithms. And also minimize the power consumption. The flow chart for this method is mentioned in Fig 8.

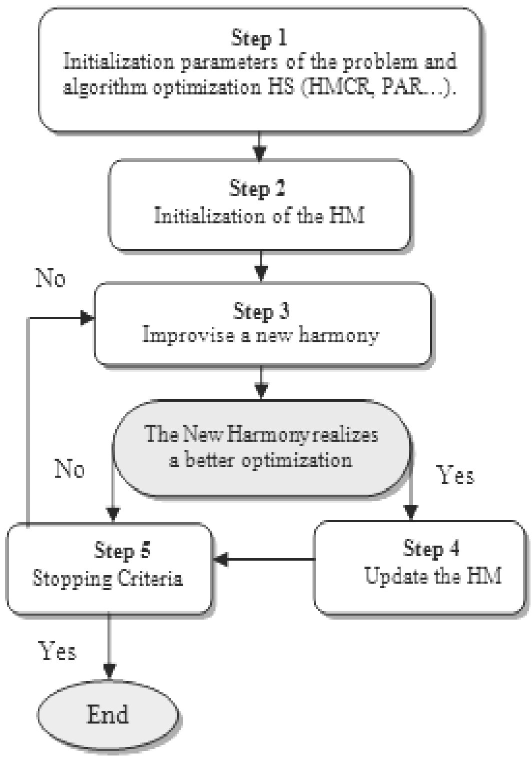

Fig 8: Flowchart for harmony algorithm

III. PROBLEM FORMULATION

A. BCDCP [4]

However, it is noted that the performance gain of BCDCP over the other clustering-based protocols decreases as the sensor field area becomes small, and its counterpart's increases with the area of the sensor field. This energy efficient routing scheme fit only for a huge range of sensing applications.

B. REACA [6]

It is efficient only a single hop which is not efficient if the two nodes are located far away from each other. Nodes are select with most energy so this causes the overhead.

C. THCHP[8]

It is a two level Hierarchical so it may increase the complexity of the wireless sensor networks and also system may slow down.

D. O-LEACH[9]

In this protocol only suited for normal sensor nodes not suited for such as hybrid sensor nodes. The number of WSN nodes is simulated for a variety of cases using different parameters so complexity increased.

E. IHS[10]

This algorithm based on only an objective function. In here the objective function are having some constant values so polishing problem may raise during search the better harmony.

IV. CONCLUSION

Thus the above methods providing efficient clustering algorithm for upgrade the network performance and the lifetime of WSN network. Although this method has several disadvantage also. In future new protocol must be developed to overcome these disadvantages and providing efficient clustering mechanism.

V. ACKNOWLEDGMENT

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