International Journal of Scientific Research & Engineering Trends
Volume 4, Issue 5, Sept-Oct-2018, ISSN (Online): 2395-566X

A Survey on various Techniques of Energy Management in Wireless Sensor Network

M.Tech.Scholar Prakash Kumar Singh
Dept.of Electronics and Communication Engg.
Rewa Institute of Technology
Rewa, MadhyaPradesh, India

***Abstract* – The availability of sensor devices allow a wide variety of applications to emerge. However, the resource constrained nature of sensors raises the problem of energy: how to maximize network lifetime despite a very limited energy budget. This paper gives a concise study of WSN (Wireless Sensor Network) energy balancing methods proposed by different researchers. Different sorts of requirement of protocols for managing WSN was additionally talked with their significance and limitations. In this study as per working steps of techniques are categorized, so a comprehensive and comparative understanding of existing literature was detailed**.

***Keywords*- Cloud Computing, Load balancing, Machine Learning, Soft Computing, Virtual machines etc.**

I. INTRODUCTION

Wireless Sensor Network (WSN) is future machinery, which has a wide range of purpose, including infrastructure protection and industrial sensing. This kind of network, usually consists of a huge number of nodes that bring them together to form a network. The most imperative consideration for a wireless sensor network is power consumption. Though the applications of WSN are extremely ample and attractive, the WSN will not be adopted in most of these applications if batteries are to be changed constantly. Therefore, when the sensor node is designed, power consumption must be minimized. There are a number of strategies that can be used to reduce the average supply current of the radio, and hence the power consumption.

The problem related to the energy consumption is attempted by many methods like, providing an improved clustering algorithm, routing algorithm, data aggregation, optimizing the transmitter and receiver power, reducing data size, local data processing, etc. Among these, many of the problems could be solved by choosing an energy efficient clustering algorithm. Wireless sensor network is a power consuming system, since nodes perform with restricted power a battery which decreases its lifetime. Once deployed, the small sensor nodes are usually inaccessible to the user, and thus replacement of the energy source is not feasible. Hence, one of the most important issues that need to be enhanced in order to improve the life span of the network is energy efficiency.

Clustering is used for communication between nodes and BS, as it is energy efficient compared to single/multi-hop routing. In clustering, a sensor node in a cluster is elected Cluster Head (CH) and relays data from a sensor to a remote receiver [3]. Few CH nodes are heavily loaded, in clustering when energy depletion occurs.CH performs aggregation function on data received and sends it to BS where it is needed. LEACH is a popular routing protocol using cluster based routing to reduce energy consumption [1].LEACH divides communication into rounds with a round including a set-up phase and a steady-state phase [4].

Clustering based schemes are the most energy efficient routing protocols. In a cluster, a node is elected as CH while others are member nodes who in their respective clusters sense ambient conditions in the environment and transmit measured data to corresponding CHs [7]. CHs collect data from member nodes,aggregate them, and finally forward it to either a neighboring CH (multi-hop) or directly (single hop) to BS.

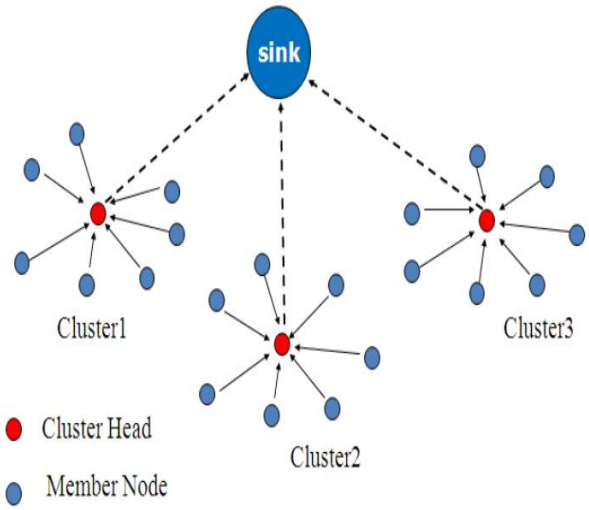

Fig.1.Cluster Based Wireless Sensor Network.

Clustering leverages advantages of small transmit distances for most nodes, requiring only a few to transmit farther distances to a BS [29]. Every sensor node in the group is associated to a single cluster and interacts only with the respective CH [17]. Hence, this means that the appropriate CH should be selected to optimize the consumption of energy by the CH; If not so, it may cause the death of CH because of additional load for data collection and forwarding. Many of the routing algorithms that are based on cluster technique first select CH at random or by probability and thereafter form the cluster.

II. ENERGY LOSSES AND TECHNIQUES FOR MANAGEMENT

Reasons of energy waste In WSNs, sensors dissipate energy while sensing, processing, transmitting or receiving data to fulfill the mission required by the application. The sensing subsystem is devoted to data acquisition. It is obvious that minimizing data extracted from transducer will save energy of very constrained sensors. Redundancy inherent to WSNs will produce huge similar reporting that the network is in charge of routing to the sink.

Experimental results confirm that communication subsystem is a greedy source of energy dissipation. With regard to communication, there is also a great amount of energy wasted in states that are useless from the application point of view, such as [4].

- **Collision-** when a node receives more than one packet at the same time, these packets collide. All packets that cause the collision have to be discarded and the retransmission of these packets is required.
- **Overhearing**-when a sender transmits a packet, all nodes in its transmission range receive this packet even if they are not the intended destination. Thus, energy is wasted when a node receives packets that are destined to other nodes.
- **Control packet overhead**-a minimal number of control packets should be used to enable data transmissions.
- **Idle listening**-is one of the major sources of energy dissipation. It happens when a node is listening to an idle channel in order to receive possible traffic.
- **Interference**-each node located between transmission range and interference range receives a packet but cannot decode it.

As network lifetime has become the key characteristic for evaluating WSN, panoply of techniques aimed at minimizing energy consumption and improving network lifetime, are proposed. We now give taxonomy of these techniques.

III.CLASSIFICATION OF ENERGY EFFICIENT TECHNIQUES

We can identify five main classes of energy efficient techniques, namely, data reduction, protocol overhead reduction, energy efficient routing, duty cycling and topology control.

1. Data reduction-focuses on reducing the amount of data produced, processed and transmitted. For instance, data compression and data aggregation are examples of such techniques.

2. Protocol overhead reduction-the aim of this technique is to increase protocol efficiency by reducing the overhead. Different techniques exist. Transmission periods of messages are adapted depending on the stability of the network, or on the distance to the source of the transmitted information. More generally, a cross-layering approach will enable an optimization of the communication protocols taking into account the application requirements. Another technique, optimized flooding can significantly contribute to reduce the overhead.

3. Energy efficient routing-routing protocols should be designed with the target of maximizing network lifetime by minimizing the energy consumed by the end-to-end transmission and avoiding nodes with low residual energy. Some protocols are opportunistic, taking advantage of node mobility or the broadcast nature of wireless communications to reduce the energy consumed by a transmission to the sink. Others use geographical coordinates of nodes to build a route toward the destination. Others build a hierarchy of nodes to simplify routing and reduce its overhead. Finally, data centric protocols send data only to interested nodes in order to spare useless transmissions.

4. **Duty cycling**-duty cycling means the fraction of time nodes are active during their lifetime. Nodes sleep/active schedules should be coordinated and accommodated to specific applications requirements. These techniques can be further subdivided. High granularity techniques focus on selecting active nodes among all sensors deployed in the network. Low granularity techniques deal with switching off (respectively on) the radio of active nodes when no communication is required (respectively when a communication involving this node may occur). They are highly related to the medium access protocol.

5. Topology control: it focuses on reducing energy consumption by adjusting transmission power while maintaining network connectivity. A new reduced topology is created based on local information.

IV.RELATED WORK

In this literature, different techniques about WSN are studied. Earlier research has tried up to a certain extent to overcome the problem of energy consumption and network stability using energy efficient techniques. However, still, energy consumption and network stability is the primary challenging issue in Wireless

Sensor Network. Therefore, we propose a technique of energy harvesting in clustering based Wireless Sensor Network to prolong network lifetime and network stability

LEACH is a well-known clustering based protocol [2]. In LEACH sensor nodes are organised into the cluster. Each cluster has cluster head and member nodes. Cluster heads in each cluster are selected randomly. The main disadvantage of LEACH is that if a sensor node with less residual energy is selected as cluster head would die quickly; ultimately the whole cluster would become non-functional. LEACH performs local processing to reduce the amount of data being transmitted to the BS, therefore reducing energy consumption and improving network lifetime.

In [3] this study, a game theory-based dispersed Energy Harvesting-Aware (EHA) algorithm is proposed, which represents the behaviors of sensors as a game. This effort analyses the energy expenditure rate and energy-harvesting rate of every sensor node at different times. In this approach, the high harvesting energy sensor nodes assist with the low harvesting energy sensor nodes to keep the connectivity of the sensor network. The proposed algorithm first builds a beginning topology based on the Directed Local Spanning Sub graph (DLSS) algorithm. Then every sensor node tries to and an adjacent node that covers up the remote neighbor of sensor node by adjusting the communication power stepwise.

In [4] this paper, a high performance met heuristic algorithm, called search-economics-based clustering algorithm (SECA),is presented. One of the basic ideas of SE-based algorithms[7] is to depict the solution space to "avoid searching the same regions too many times" and to "search the potential regions that have not been searched as often as possible."The SECA is proposed for reducing the energy consumption
of a WSN to prolong its lifetime.

In [11] this paper have proposed a new approach to improve the energy efficiency of the wireless sensor network by placing the base stations in the appropriate locations such that the squared Euclidean distances from the sensors to the base stations are minimized. We have used the concept of Hessian matrix of multi variable calculus to improve the energy efficiency and identify the base station locations such that the energy consumption is minimized.

The proposed methodology is supported with problem formulation and necessary proofs. The proposed mathematical design will significally support and improve the low-energy networks.

V.ENERGY EFFICIENT PROTOCOLS

1. LEACH (Low Energy Adaptive Clustering Hierarchy)

A proposed protocol [4] is an adaptive clustering protocol for distributing energy load among the sensor nodes in network. LEACH uses single-hop routing in which each sensor node transmits information directly to the cluster head or the sink. It works in two phase-

- The setup phase- In the setup phase ,the cluster are organized and the cluster heads are selected and each round stochastic algorithm is used by each node to determine whether it will become a cluster head.
- The steady state phase- The data is sent to the base station the duration of the steady state phase is longer than the duration of the setup phase in order to minimize overhead. Cluster head creates a TDMA (Time Division Multiple Access) schedule based on the number of nodes in the group. CDMA (Code Division Multiple Access) code is used for random communication inside the cluster. LEACH is not suitable for large network areas.

2. PEGASIS (Power efficient gathering in sensor information systems)

A greedy chain protocol [5] which resolves the data-gathering problem of the wireless sensor networks. The main thing is for each node to receive from and transmit to close neighbors' and take turns being the leader for transmission to the base station. This approach will distribute the energy load evenly among the sensor nodes in the network. Initially the nodes are placed randomly in the field, and the sensor nodes are arranged to form a chain, which can either be accomplished by the sensor nodes themselves using a greedy algorithm starting from some node. Alternatively, the base station can compute this chain and broadcast it to all the other sensor nodes.

For constructing the chain, all nodes have global knowledge of the network and then employ the greedy algorithm. A loop will be constructed to ensure that all nodes have close neighbours is difficult as this problem is similar to the travelling salesman problem. The greedy approach to constructing the chain is done before the first round of communication. It shows better results as compared to LEACH by removing the overhead of dynamic cluster formation, reducing the number of transmissions, and using only one transmission to the base station per round and shows better improvement if the network size increases.

3.PEACH (Power-efficient and adaptive clustering hierarchy)

A protocol, [6] which is a power-efficient and adaptive clustering hierarchy protocol for wireless sensor networks. In wireless sensor networks, by overhearing a node can recognize the source and the destination of packets transmitted by the neighbor nodes. Based on the overheard information, PEACH forms the clusters without additional packet transmission overhead such as

advertisement, announcement, joining, and scheduling messages. PEACH is designed to operate on probabilistic routing protocols, in order to provide an adaptive multilevel clustering. As a result of the protocol design, PEACH is generally more scalable and efficient to the various circumstances than the existing clustering protocols of the wireless sensor networks. PEACH can be used on both location-unaware and location-aware wireless sensor networks.

The location-unaware PEACH protocol can be used when the location information of each node is unavailable on the network. The location-aware PEACH operates when the localization mechanism such as a GPSlike hardware is available on sensor nodes. The communication cost in WSN is decreased by the reducing the data packets, and the clustering protocols improve the lifetime and the energy consumption of the wireless sensor networks. PEACH has no overhead on cluster head selection and forms adaptive multi-level clustering as compared to the existing clustering protocols.

4.TEEN (Threshold sensitive energy efficient sensor network protocol)

This is the first protocol developed for reactive networks. In this protocol [7] at every cluster change time, the cluster-head broadcasts to its members. Thus, the hard threshold tries to reduce the number of transmissions by allowing the nodes to transmit only when the sensed attribute is in the range of interest. The soft threshold further reduces the number of transmissions by eliminating all the transmissions which might have otherwise occurred when there is little or no change in the sensed attribute once the hard threshold. TEEN is well suited for time critical applications and is also quite efficient in terms of energy consumption and response time.

It also allows the user to control the energy consumption and accuracy to suit the application. The main drawback of this scheme is if the thresholds are not achieved, the nodes will never communicate, the user will not get any data packet from the network and will not come to know about the nodes if they die. Thus, this scheme is not well suitable for applications where the user wants to get data regularly. Another problem is that a practical implementation would have to ensure that there collision-free cluster.

5. EEABR (Energy Efficient Ant-Based Routing)

Proposed protocol [8] which is based on the Ant Colony Optimization heuristic. Initially the forward ants are sent to no specific destination node, which means that sensor nodes must communicate with each other and the routing tables of each node must contain the identification of all the sensor nodes in the neighborhood and the correspondent levels of pheromone trail. For large networks, this can be a problem since nodes would need to have big amounts of memory to save all the information about the neighbouring nodes. The algorithm can be easily changed to save memory. If the forward ants are sent directly to the sink, the routing tables only need to save the neighbour nodes that are in the direction of the sink. This reduces the size of the routing tables and, in consequence, the memory needed by the nodes. The quality of a given path between a sensor node and the sink-node, should be determined not only in terms of the distance, but also in terms of the energy level of that path.

6. SOP (Self-organizing protocol)

Proposed protocol [9] which includes cluster architecture of LEACH with multi-hop routing to decrease transmission energy. In many WSN multi-hop routing is adopted. This makes a node that wants to transmit data to a destination node find one or multiple intermediate nodes. The communication occurs among all the nodes until the data packets reach the destination [10]. In brief, the data packets take several hops among the nodes in the network. The main advantage of this approach is that transmission energy consumption is reduced. But at the same time latency of the network and delay of data packets will increase.

In some cases, no rigid requirements on latency, the multi-hop routing can lead to high energy efficiency. In this protocol when clusters are organized, the cluster heads form a multi-hop routing backbone. Every cluster member node sends data to the cluster head directly for the communication purpose. While for the communication between the cluster head and the base station, a multi-hop routing is adopted to reduce the transmission energy and minimize the difference of energy consumption among all nodes in the network.

VI.CONCLUSIONS

The wireless sensor networks continue to grow and become widely used in many applications. So, the need for security becomes vital. However, the wireless sensor network suffers from many constraints such as limited energy, processing capability, and storage capacity, etc. Consequently, many innovative security protocols and techniques have been developed to meet this challenge. In future a flawless calculation is with great component blend is wanted by investigating new load balancing calculations which adjusts the load much better and furthermore helps in green processing.

REFERENCES

[1]. Faheem khan, Sohail abbas, Samiullah khan, An Efficient and Reliable Core-Assisted Multicast Routing Protocol in Mobile Ad-Hoc Network, International Journal of Advanced Computer Science and Applications, vol7:5, 2016.

[2]. M. J. Usman, Z. Xing, H. Chiroma, A. Y. U. Gital, A. I. Abubakar, A. M. Usman and Herawan,

Modified Low-Energy Adaptive Clustering Hierarchy Protocol for Efficient Energy Consumption in Wireless Sensor Networks for Healthcare Applications, International Review on Computers and Software, vol. 9, no. 11, pp. 1904-1915, 2014.

[3]. T. Qian, A. Wei, Y. Han, Y. Liu and S. C, Energy Harvesting Aware Topology Control with Power Adaptation in Wireless Senso

[4]. Chun-Wei Tsai, Zhen-An Liy, Ming-Chao Chiang and Chu-Sing Yang. "A novel clustering algorithm for wireless sensor network based on search economics". 2017 IEEE International Conference on Systems, Man, and Cybernetics (SMC) Banff Center, Banff, Canada, October 5-8, 2017.

[5]. S. Lindsey and C. S. Raghavendra., "PEGASIS: PowerEfficient GAthering in Sensor Information Systems"02 WZ IEEE EEFAC p a p #242, Updated Sept 29,2001

[6]. S. Yi, J. Heo, Y. Cho, J. Hong., "PEACH: Power-efficient and adaptive clustering hierarchy protocol for wireless sensor networks" ELSEVIER Computer Communications 30 (2007) 2842–2852

[7]. A. Manjeshwar and D. P. Agrawal., "TEEN: A Routing Protocol for Enhanced Efficiency in Wireless Sensor Networks" IEEE 2001.