Analysis of Energy Efficient Routing Techniques for Wireless Sensor Network: A Review

Jyoti Tiwari
Research Scholar, Department of CSE
All Saints' College of Technology Bhopal, (M.P.) India

Syed Imran A. Qadri
Assistant Professor, Department of CSE
All Saints' College of Technology Bhopal, (M.P.) India

Abstract: ***WSN attract the researchers more due to their popular applications in environment monitoring, radiation and nuclear-threat detection structure; weapon sensors for ships; battlefield reconnaissance and surveillance; military power, control, intelligence, communications and targeting systems and biomedical aspects. Wireless sensor networks can provide low cost solution to various real-world problems. Sensors are low cost devices with limited storage, computational power. Any security mechanism for sensor network must be energy efficient as security is the major concerned when they will be used in large scale as sensors have limited power and computational capability and should not be computational intensive. Here we study the energy-efficient secure routing protocol for wireless networks based on data aggregation we observed in our study following energy-efficient techniques which are Designated path (DP) Scheme, TDMA as the MAC layer Protocols, EF-Tree (Earliest-First Tree) and SID (Source-Initiated Dissemination) According to Fuzzy Variables, Energy Efficient Clustering Protocol (Fz-Leach), OEERP (Optimized Energy Efficient Routing Protocol), It is a cluster based protocol and Enhanced Heterogeneous LEACH (EHE-LEACH) Protocol for Lifetime Enhancement of SNs. Although Sensors don't participate in the routing scheme their energy is conserved at each sensor node.***

Key Words: WSN, Low-Energy Adaptive Clustering Hierarchy (LEACH) & Secure Positioning for Sensor Networks (SPIN).

I. INTRODUCTION

LEACH protocol performs the grouping of nodes in to clusters, here local interactions among the cluster members (CMs) is controlled by CH. In addition to this CH have more than a few responsibilities like local data reception, aggregation and fusion, this process controlled the energy of sensor nodes and effectively prolong the lifetime of network field. CHs are most relying sensor nodes as these are taking the responsibility of data transmission to the BS, consume more energy. Therefore the role of CH is dynamically changed such that the high-energy utilization in data transmission to the BS is distributed to all the sensor nodes in the system. LEACH-C used centralized approach and considers the remaining energy. The operation of LEACH and LEACH-C is controlled by rounds, which consist of two phase setup phase and steady state phase. CHs are selected in setup phase and allocate the TDMA schedule to the respective CMs. While in the steady state phase, data communication between the CMs and the CH is performed. A CM in a cluster is active only during its allocated time slot, while CHs are active all the time in steady state phase. LEACH performs periodic CH selection, the energy utilization burden of the CHs is also shared. The duration of the steady state phase is longer than the duration of the setup phase. Study shows that LEACH provides a factor of 4–8 reduction in energy consumption compared to a flat-architecture routing protocol. Major disadvantage of this protocol is that they do not consider the residual energy of sensor nodes and assume zero energy consumption for the formation of cluster.

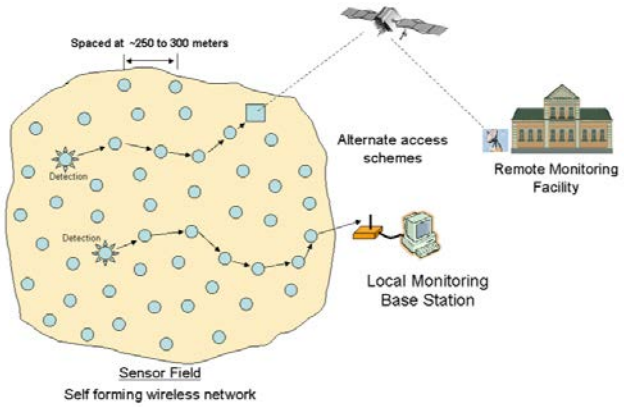

Fig. 1 Shows the WSN

The potential of wireless sensor network lies in their flexibility and scalability. The capability of self-organize and wireless communication made them to be more useful in an ad-hoc fashion in remote or risky location without the need of any existing communications. In the course of multi-hop communication, a sensor node can communicate a remote node in the network. These allow the adding of sensor nodes in the network to make bigger the monitored area and hence prove its scalability and flexibility assets. The main challenge in sensor networks is to maximize the lifetime of sensor nodes due because it is not feasible to replace the batteries of several sensor nodes therefore nodes and communication protocols must be made as energy proficient as possible. Among these protocols data transmission protocols have very importance in terms of energy since the energy required for data transmission takes seventy percent of

the total energy consumption of a WSN [2]. Area covering and data aggregation [6] techniques can greatly help conserve the inadequate energy resources by eliminating data redundancy and minimizing the number of data transmissions. Therefore, data aggregation methods in sensor networks are widely investigated in the literature [6], [7], [8] and [9].

Security in data communication is another significant issue to be considered while designing wireless sensor networks, as wireless sensor networks may be deployed in hostile areas such as battlefields [2], [10] and [11]. Therefore, data aggregation protocols should work with the data security protocol, as any clash between these protocols might create loopholes in network security.

Presently there are various types of commercially available sensor nodes. University of California at Berkeley has developed Mica mote which is a special purpose sensor node. Other special purpose sensor nodes available are Spec, Rene, Mica 2, Telos etc. Some high bandwidth sensor nodes available are BT Node, Imote 1.0, Stargate, Inryonc Cerfeube etc. [12]. Wireless sensor networks are potentially one of the most significant technologies of this era. Current progress in wireless communications and electronics has enabled the growth of low-cost, low power, multifunctional miniature devices for use in remote sensing applications. The arrangement of these factors has enhanced the sensibleness of utilizing a sensor network consisting of a large number of elegant sensor, enable the compilation, processing analysis and dissemination of important information gathered in types of environments. A sensor network is self-possessed of a large number of nodes of sensor, which consist of sense, information processing and communication ability. Sensor network protocols and algorithms must possess self-organizing abilities. Another unique characteristic of sensor networks is the cooperative effort of sensor nodes. Sensor nodes are fit with an onboard CPU. Rather than sending the raw information to the nodes responsible for the synthesis, they use their processing abilities to locally carry out simple computation and transmit only the required and partially processed data. Sensor networks are mainly data-centric rather than address-centric so sensed data are directed to an area containing a cluster of sensors than particular sensor addresses. The similarity in the data obtained by sensors in a dense cluster, aggregation of the data is performed. That is, an aggregator node inside the group, thus falling the communication bandwidth requirements, prepares a summary or analysis of the local data. Aggregation of data increases the level of accuracy and reduces information redundancy. A system order and clustering of sensor nodes allows for network scalability, toughness, capable resource utilization and lower power consumption. The essential objectives for sensor networks are reliability, precision, flexibility, cost effectiveness and ease operation.

II. SYSTEM MODEL

The performance of a safe routing protocol [12] is closely depended on the architectural model and design of the wireless sensor networks, base on the application necessities various architectures and design goals have been considered for sensor networks to capture architectural issues and highlight their implications describe basic configuration of a simple sensor node that depends on the application requirement.

Node Capability: Depending on the kind of work a node can be dedicated to a particular special function such as relaying, sense and integration as engaging the three functionalities at the same time on a node may quickly drain the energy of that node. Inclusion of heterogeneous set of sensors raises multiple issues making data routing more demanding.

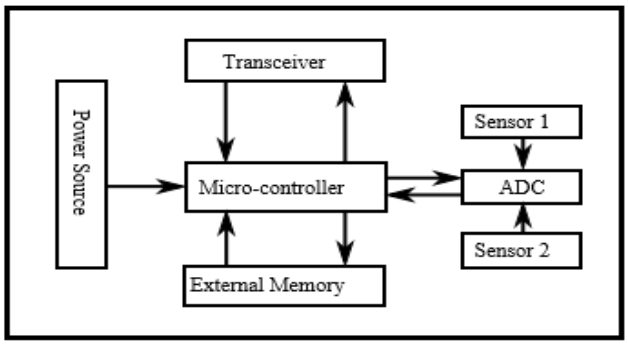

Fig. 2 The typical architecture of the sensor node.

Delivery Model: Based on application requirement of the sensor network, the information delivery model to the sink can be continuous or event-driven or query-motivated and mixture. In the continuous delivery representation, every sensor sends data occasionally. In incident-driven and uncertainty driven models, the transmission of data is triggered when an event occurs or a query is generated by the sink. Some networks apply a hybrid model using a combination of continuous, event-driven and query-driven data delivery.

Data Aggregation: In the wireless sensor network, sensor nodes might generate redundant data; similar packets from multiple nodes can be aggregated so that the number of transmissions would be concentrated. Data aggregation is the blend of data from various sources by using functions such as suppression (eliminating duplicates), minimum, maximum and average some of these functions can be performed by the aggregator sensor node, by allowing sensor nodes to conduct in-

network data reduction. Recognizing that computation would be low energy consuming than communication, considerable energy savings can be obtained through data aggregation.

Energy Consideration: Energy is very significant parameter during the creation of an communications, and the procedure of selecting the route for broadcast. Since the transmission, power of a wireless radio is proportional to distance squared or even higher order in the presence of obstacles, multihop routing will consume less energy rather than direct communication. However, multihop routing introduces significant overhead for topology management and medium access control. Direct routing would perform good enough if all the nodes were very near to the sink.

Applications of Sensors:

Fig. 3 shows the major roles of WSNs in various applications.

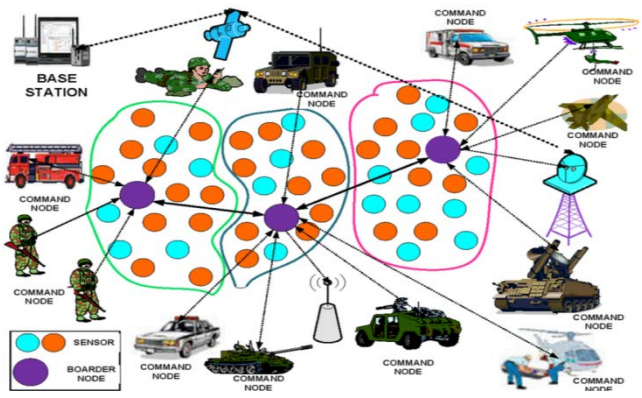

Fig 3- Applications of Wireless Sensor Networks

III. LITERATURE SURVEY

Nikunj K. Pandya, H. J. Kathiriya, N. H. Kathiriya presented the Energy efficiency is resent issue in wireless sensor network (WSN). Hierarchical routing or Clustering is best solution for reducing energy consumption in WSN. LEACH (Low energy adaptive clustering hierarchy) is good hierarchical protocol. There are many protocols introduced based on LEACH but still have issue of energy efficiency. Lots of research is going on CH (cluster head) election algorithm, data aggregation, reducing number of transmission and different power levels. MODLEACH (Modified LEACH) uses three transmission power levels which reduces energy consumption in network; also it uses different cluster head election algorithm in which node have remaining energy greater than threshold it remain as cluster head for next round. Equation used in MODLEACH for electing cluster head was same as used in LEACH. Authors enhanced MODLEACH by using different equation for cluster head election as used in HEED (Hybrid Energy-Efficient Distributed clustering) such that it elect node as cluster head based on remaining energy of node. Also we enhanced MODLEACH by putting energy hole removing mechanism such that if node has energy less than threshold, it puts a node into sleep mode.

In 2010 Yanwei Wu; Xiang-yang Li; Mo Li; Wei Lou, [12] proposed "An Energy-Efficient Wake-Up Scheduling for Data Collection and Aggregation". A sensor in wireless sensor networks periodically produces data as it monitors its area. The fundamental operation in such a network is the systematic gathering (with or without in-network aggregation) and transmitting of sensed data to a base station for further processing. A key major challenge in WSNs is to schedule nodes' activities to reduce energy consumption. This research work focused on designing energy-efficient protocols for low-data-rate WSNs, where sensors consume various energy in various radio states (receiving, transmitting, sleeping, listening, and keep idle) and consume energy for state transition. With the use of TDMA as the MAC layer protocol and schedule the sensor nodes with consecutive time slots at various radio states while reducing the number of state transitions.

In 2010 Arabi, Z.,[13] proposed "HERF: A hybrid energy efficient routing using a fuzzy method in Wireless Sensor Networks". This research work focused on Data dissemination is an significant task performed by WSNs. The algorithms of this system depend on a number of factors such as application areas, practice condition, power, and aggregation factors. With respect to these parameters, various algorithms are recommended. An algorithm for hybrid energy efficient routing in wireless sensor networks, which used two algorithms, i.e. EF-Tree (Earliest-First Tree) and SID (Source-Initiated Dissemination) to disseminate data, and employs a fuzzy method to choose group head, and to toggle between two methods, SID and EF-Tree.

In 2011 Katiyar, V.; Chand, N.; Gautam, G.C.; Kumar, A., [14] worked on "Improvement in LEACH protocol for large-scale WSNs". The LEACH protocol is a hierarchical clustering protocol that provides an elegant solution for such protocols. One deficit that affects the presentation of the procedure is endurance of very large and very small clusters in the network at the similar time. This leads to reduce in life span of WSNs. This research work focused to analyze a new energy proficient clustering protocol (FZ-LEACH) that eliminates the above problem by forming Far-Zone. It is a group of sensor nodes, which are placed at locations where their energies are less than a threshold. The results and study show that planned FZ-LEACH algorithm

outperforms LEACH in terms of energy consumption and network existence.

In 2012 Chand, K. K.; Bharati, P.V.; Ramanjaneyulu, B.S., [15] investigated "Optimized Energy Efficient Routing Protocol for lifetime improvement in Wireless Sensor Networks". This research work presents a new routing protocol named Optimized Energy Efficient Routing Protocol (OEERP) that improve the lifetime of WSN. It is a cluster based protocol in which the node that acts as cluster-head is changed in each time period. This way enhances the lifetime of the WSN for two reasons primarily. The first cause is the consistent battery drain of the nodes and the second reason is that no node depends on beacon-based transmissions for long time to reach the contact point. Data sensing and performing data aggregation are also carried out in such a way to reduce the number of transmitted messages to the entrance point. This procedure can be use for any sporadic monitoring application using WSN.

In 2013 Tyagi, S.; Gupta, S.K.; Tanwar, S.; Kumar, N.,[16] researched on "EHE-LEACH: Enhanced heterogeneous LEACH protocol for lifetime enhancement of WSNs". They, focused an Enhanced Heterogeneous LEACH (EHE-LEACH) Protocol for Lifetime Enhancement of Sensor Networks. A preset distance based threshold is used for the bifurcation of direct communication and cluster based communication in the planned scheme. WSNs near to the BS be in touch straight and those which are distant from the Base use group based communication. To assess the act of the proposed system two key parameters known as: Half Nodes Alive (HNA) and Last Node Alive (LNA) are selected. By selecting the distance based threshold with the ratio of 1:9 between direct communication and cluster based communication it has been observed that EHE-LEACH has better network lifetime with respect to various parameters in comparison to the other well known proposals such as LEACH and SEP. CONCLUSIONS AND FUTURE SCOPE

It has been observed in literature review that Extended Heterogeneous LEACH protocol for wireless SNs the energy efficiency, extended life time and improved system stability make EHE-LEACH an attractive protocol for wireless SNs. In order to improve the stability of the network system and lifetime Observations show that EHE-LEACH has better lifetime and stability of the system as compared with LEACH and SEP for same energy level. We compared EHE-LEACH with LEACH and other all protocol techniques mention in literature review table but due to the presence of various clustering algorithms that we need to evaluate and in future other factors can have an effect on the network lifetime.

IV. PROPOSED METHODOLOGY

The wireless sensor network a subset of mobile ad-hoc network has lot of challenges to reduce the energy consumption of sensor nodes or wireless nodes to live longer in network and keep communicating with the network. Here we have to work out main areas by which a node can live longer and i.e. either make batteries (source of energy) equipped with nodes having larger in size or the material having larger charges saving capability but this approach having limited capabilities because the larger battery size make sensor node more bulk which is not feasible in any case, and to finding out the material has larger charge storing capability is also tough task to do.

Instead doing above things another method is to make transfer of information on network more efficient. For this many routing protocols has been given as we discussed in the previous sections.

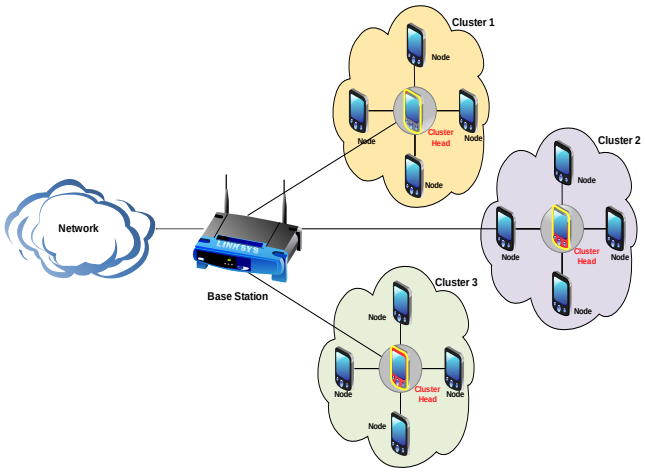

Fig. 1 Network Diagram of Proposed Methodology

To enhance the performance of the existing system, we can make changes in one of the routing protocol, where changes will be made in the probability of election of protocols to enhance the lifetime of the wireless sensor network.

Another approach is to modify the initialization energy of nodes so that the nodes will send information for more number of transmission rounds.

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clustering algorithms that we need to evaluate and in future other factors can have an effect on the network lifetime. For future work, a model with heterogeneous wireless sensor nodes with its topology to have good energy efficient and increasing lifetime network may be investigated in different future requirements.

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