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A Review of Different Energy Efficiency Techniques in Wireless Sensor Networks

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Abstract: Wireless device Networks have many problems and complications that required to be notice. The energy consumption of the nodes and therefore the extension of the network period are the core challenges. The most vital options of the routing protocol so as to create it appropriate, effective for WSNs. The work is how to decide the sensor nodes density to guarantee a full coverage and to reduce energy consumption in a sensor network. During this paper there's a shot to allow a large comparison of the routing protocols in WSNs. Moreover, extracting the strengths and weaknesses of every protocol, providing a comparison among them, together with some metrics like measurability, mobility, power usage etc. to create it perceivable and straightforward to select the foremost appropriate one as per the need of the network.

Keywords: WSNs, Power, Life time, Coverage.

I. INTRODUCTION

Wireless Sensor Networks is a wireless network consisting of small nodes with sensing, computation, and wireless communications capabilities over short distances. Each sensor collects data from the monitored area and then it routes data back to the base station BS. The sensors can be placed in the field randomly or in a pre-determined manner.

As wireless sensor networks consist of hundreds to thousands of low-power multi functioning sensor nodes, operating in an unattended environment, with limited computational and sensing capabilities. Sensor nodes are equipped with small, often irreplaceable batteries with limited power capacity[1]. WSN consist of hundreds or thousands of small, cheap, battery-driven, spread-out nodes bearing a wireless modem to accomplish a monitoring or control task jointly.

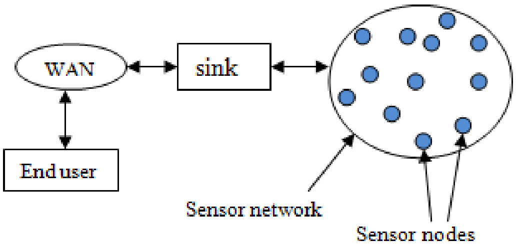

Fig 1.1 : Wireless sensor networks

Components of Wireless Sensor Networks

1.1 Sensor

A sensor is an electromechanical device which can sense any many physical, motion, contact, presence/absence, bio-chemical and identification properties of any real object. It actually a Transducer in the concept of electronics which converts any sensed properties of object into equivalent electrical signal.

1.2 Sensor Node

Sensor Node are use to create Sensor network. This is the basic unit in a sensor network and is capable of performing some processing, gathering sensory information, and communicating with other connected nodes in the network[20]. The sensor nodes in a sensor network are usually resource constrained, which means they have limited energy, limited processing and memory capability as well as limited transmission range. A WSN consists of multiple sensor nodes is deployed carefully or arbitrarily over a given field. A sensor node typically comprises four parts: one or more sensors, a microcontroller, a wireless transceiver, and a power source. Batteries are commonly used to power nodes in a WSN deployment but have a finite energy budget. When the battery is depleted, a node cannot perform its function or participate in packet routing, which can isolate large areas of the network. Charging or replacing batteries may be expensive and is difficult or even impossible under many circumstances. Therefore, the life of a sensor network is usually defined by the time interval between which a certain amount of critical nodes run out of their battery power [2].

1.3 Sink/Base station

The base station is upper level of the hierarchical WSN. It provides the communication link between the sensor network and the end-user.

1.4 End User

An end user is the person that a software program or hardware device is designed for. The end user can be contrasted with the developers or programmers of the product. End users are also in a separate group from the installers or administrators of the product.

II. RESEARCH ISSUES IN WIRELESS SENSOR NETWORKS

The design of WSNs is influenced by many challenging factors. These factors must be overcome so that efficient communication can be achieved in WSNs. Here, some of the routing challenges and design issues that affect routing process in WSNs. **Security and Privacy:** Sensor networks interact closely with their physical environment and with people, posing additional security problems. Because of these reasons current security mechanisms are inadequate for WSNs. These new constraints pose new research challenges on key establishment, secrecy and authentication, privacy, robustness to denial-of-service attacks, secure routing, and node capture. To achieve a secure system, security must be integrated into every component, since components designed without security can become a point of attack. Consequently, security and privacy should be provided to every aspect of system design. One challenge is how to secure wireless communication links against eavesdropping and tampering. Overall, security is a difficult challenge for any system. The severe constraints and demanding environments of WSN make computer security for these systems even more challenging [3].

Coverage: In WSNs, each sensor node obtains a certain view of the environment. A given sensor's view of the environment is limited both in range and in accuracy; it can only cover a limited physical area of the environment. Hence, area coverage is also an important design parameter in WSNs [4].

Data Aggregation: Since sensor nodes may generate significant redundant data, similar packets from multiple nodes can be aggregated so that the number of transmissions is reduced. Data aggregation is the combination of data from deferent sources according to a certain aggregation function, e.g., duplicate suppression, minima, maxima and average. This technique has been used to achieve energy efficiency and data transfer optimization in a number of routing protocols [4].

Quality of Service: In some applications, data should be delivered within a certain period of time from the moment it is sensed; otherwise the data will be useless. Therefore bounded latencyfor data delivery is another condition for time-constrained applications. However, in many applications, conservation of energy, which is directly related to network lifetime, is considered relatively more important than the quality of data sent [4].

Small Storage Size: The storage size of a sensor node is very small as compared with to those in traditional networks. This constraint of sensor node makes the wireless sensor networks unsuitable to be employed in applications that require high data storage capacity. Further, the data processing and data communication becomes limited due to small storage size [5].

Fault Tolerance: Some sensor nodes may fail or be blocked due to lack of power, physical damage, or environmental interference. The failure of sensor nodes should not affect the overall task of the sensor network. If many nodes fail, MAC and routing protocols must accommodate formation of new links and routes to the data collection base stations [4].

Energy Efficiency: In wireless sensor network, energy is a main constraint. The operations of a sensor node, such as data processing and transmission are energy-consuming; it is easy to drain the energy of the node during network operation. This problem becomes worsened by the fact that nodes in some applications of wireless sensor networks are left unattended. For example, in a field surveillance application, sensor nodes are distributed in an inaccessible territory. Recharging or replacing the node batteries is impossible. Furthermore, the replacement of all node batteries in a large area is costlier and unrealistic. Therefore, limited energy of the node is a crucial challenge for the design of wireless sensor networks [5].

A great deal of research has focused to increase the lifetime of the network . A major factor for the power consumption in a sensor node in sensor network is due to the transmit ion of electrons, which increases with the increment of

(1) The amount of data to be transmitted
(2) The distance between the transmitter and the receiver.
(3) The collision between nodes.

One side to contemplate for energy effectiveness is that the communication scheme, because it is the main energy shopper in WSNs [6]. It consumes seventieth of network energy. The energy consumption is often reduced with efficiency through correct cluster head choice and message minimization in knowledge reportage.

WSNs area unit essentially the gathering of wireless nodes having restricted energy capabilities, area unit deployed arbitrarily over a dynamically dynamic atmosphere, could also be mobile or stationary, for observing physical phenomena like humidness, temperature, health observation, vibrations, unstable events etc. [7][8]. Choosing a routing strategy is that the core issue for gathering and delivering the economical packets of helpful data to the required destination. So the routing strategy ought to guarantee the smallest amount energy consumption leading to increasing the network's life [9]. The WSNs could also be utilized in the variability of lifestyle activities or services.

III. HIERARCHICAL NETWORK ROUTING PROTOCOLS

Many protocols have been proposed for energy-efficiency in WSN in the last few years. Clustering based schemes are believed to be the most energy efficient routing protocols for wireless sensor networks. Clustering is grouping of similar objects or the process of finding a natural association among some specific objects or data. In each cluster, one node is elected as the cluster-head (CH) while the rest of the nodes are member nodes. Here,we review some clustering methods.

3.1 LEACH: "Low-Energy adjustive cluster Hierarchy": during this form of stratified protocol, most of the nodes communicate to cluster heads [10].

LEACH consists of 2 phases:

The Setup Phase: during this phase, the clusters square measure ordered so C.H has been selected. The task of C.H is to pile up, wrapping, and forward the knowledge to the bottom station (Sink).but question is that how it'll be determined, that that node are C.H "Stochastic algorithm" are employed in this spherical of choice. however it'll be applied with a condition that, if a node are C.H, successive time it'll not be selected within the "P- Round". It means in every around the risk to become the CH for every node is 1/P. by doing this a scientific rotation of the nodes in every spherical leads toward balanced energy consumption by all the nodes and so can enhance the period of time of the network.

The Study State Phase: within the previous state, the nodes and therefore the C.H are organized, however within the second state of "LEACH", the data is communicated to the bottom station (Sink). length of this section is longer than the previous state. to reduce the overhead, the duration of this section has been multiplied. every node within the network, contact with the cluster head, and transfer the information thereto, after that C.H can develop the schedule to transfer the information of every node to base station. D.A. Vidhale et al describes main benefits of this technique as "it outperforms standard communication protocols, in terms of energy dissipation, simple configuration, and system lifetime/quality of the network" As per these benefits, "wireless Distributed protocol" can facilitate pave the manner in "WSN". Basically in the "LEACH", the "single hop" routing has been used, during which every node will be transmitted on to the sink (Base Station). It's a way of dynamic cluster, that facilitate to further overhead just like the advertisements, that leads toward the reduce the addition in energy consumption.

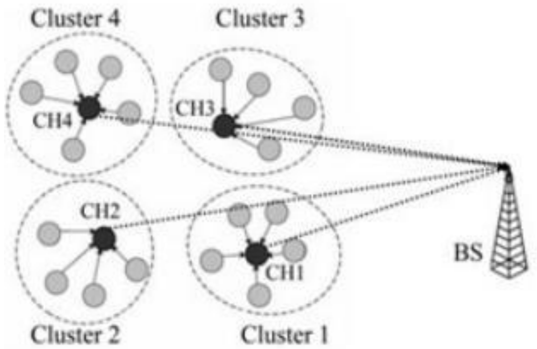

Fig 3.1: The LEACH Clustering Communication hierarchy[11]

LEACH-C "Low-Energy adjustive cluster Hierarchy Centralized: As compare to the "LEACH", the bottom station is employed to develop the C.H, rather than nodes are organized themselves into the C.H [11]. however the BS (Base Station) can add this reference to develop the C.H foremost the BS obtains knowledge as per the placement energy level of each node within the network. On the second stage it'll realize a recent range of C.H and therefore the at that time it'll be organizes the network into the clusters. it's been completed in relation to curtail the energy, necessary for non CH nodes to convey their info to their explicit cluster heads.

Following square measure the enhancements as compare to "LEACH":

- The BS uses its universal information of the network to form clusters that necessitate less energy for knowledge broadcast.
- In "LEACH-C" the quantity of C.H in every spherical equals a planned optimum price.

3.2 PEGASIS "Power-Efficient Gathering in detector info Systems": it's a "chain-bases protocol" Associate in Nursing an upgrading of the "LEACH" [12]. The main idea in PEGASIS is for each node to receive from and transmit to close neighbors and take turns being the leader for transmission to the BS. This approach will distribute the energy load evenly among the sensor nodes in the network. In "PEGASIS" each node transfers solely with a detailed neighbour to direct and acquire info. It receipts turns communication to the BS, so decreasing the amount of energy consumed per round. The nodes square measure during this manner that a sequence ought to be developed, which might be completed by the detector nodes along side exploitation an formula. On the opposite hand, the BS will reason this chain and transmission of it to all or any the detector nodes. Within the simulation, it's completed in a very system that has one hundred set nodes however at random. The BS is found at a far off distance from all the remaining nodes. Thus, for "a 50m x 50m plot", the BS is set at "(25, 150)" so the BS is a minimum of "100m" remote off from the neigh boring detector node. To develop the chain, it's expected that each one nodes have universal info of the system which a greedy formula is engaged. Thus, the structure of the chain can begin from the remote node to the nearer node. If a node expires, the chain is remodelled within the similar methodology to avoid the lifeless node.

Overall, the “PEGASIS” protocol offerings 2 or over 2 presentations in distinction with the “LEACH” protocol [13], [14]. Though, the “PEGASIS” protocol reasons the pink-slipped knowledge broadcast in the meantime one in all the nodes on the sequence has been carefully chosen. in contrast to “LEACH”, the transference distance for many of the nodes is condensed in “PEGASIS”. Investigational consequences show that “PEGASIS” delivers improvement by issue two compared to “LEACH” protocol for “50m x 50m network” and upgrading by issue three for “100m x 100m network”. The “PEGASIS” protocol, though, contains a major problem that's the terminated broadcasting of the information. the explanation of this problem is that there's no thought of the BS’s location for the energy of nodes once one of nodes is appointive as head of node.

IV. COVERAGE TECHNIQUES IN WSN

A fundamental issue in WSNs is the quality provided by the network. This quality is usually measured by how well deployed sensors *cover* a target area. In its simplest form, coverage means that every point in the target area is monitored by, i.e., within the sensing range of, at least one sensor. This is called 1-coverage. k-coverage ($k \geq 1$) problemis that where each point should be within the sensing range of k or more sensors.

A sensor network is considered to be full covered if there is no vacant region is the network space. One of the major challenges in constructing a good sensor network is to maintain long network lifetime as well as full coverage.

V. EXPERIMENT AND RESULTS

In this section a comparative study is done to validate the results of two energy efficiency protocols called LEACH and PEGASIS. The parameters used are Delay, Load, Data traffic, Throughput, Data dropped etc. To compare these two protocols OPNET simulator is used with 20 number of nodes. In this LEACH and PEGASIS is implemented with 2 different scenarios in OPNET. In all scenarios traffic is generated with a speed of 100 packets, channel sensing duration s 0.1. With the establishment of all the parameters following results are generated.

5.1 Delay:

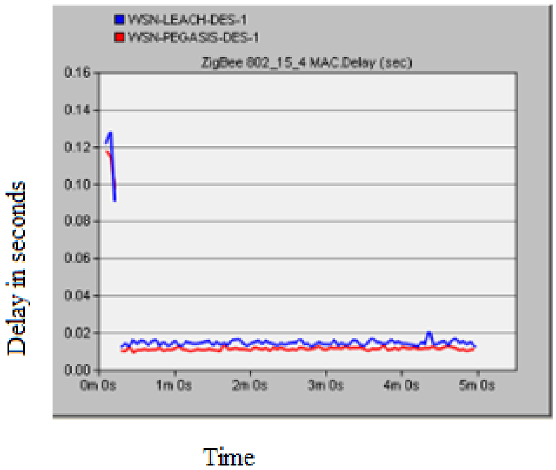

Fig 5.1: Delay(sec)

Fig 3.1 is presenting the delay in the PEGASIS and LEACH protocols. Here, X-axis represents the optimized time and Y-axis represents the delay. From the graph shown above it is very clear that the delay in LEACH is slightly higher than that of the PEGASIS. In LEACH value is approx 0.019sec where as in case of PEGASIS it is approx 0.016sec. From the above defined scenario it is very clear that the PEGASIS is better than that of LEACH in case of delay.

5.2 Load:

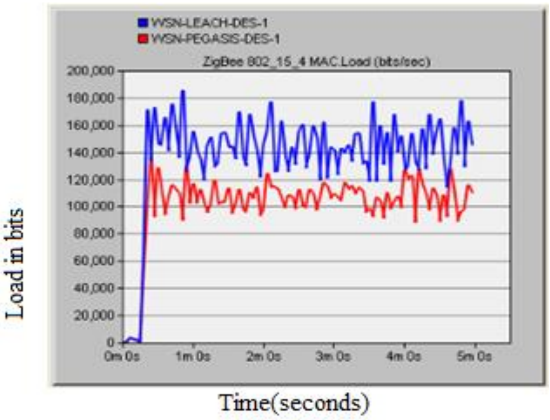

Fig 5.2: Load (bit/sec)

Fig 5.2 is presenting the load in the PEGASIS and LEACH protocols. Here, X-axis represents the optimized time in seconds and Y-axis represents the load in bits. From the graph shown above it is very clear that the load in LEACH is higher than that of the PEGASIS. In LEACH value is approx 150,000 bits/sec where as in case of PEGASIS it is approx 110,000bits/sec. The scenario depicts that the load in PEGASIS is less than LEACH so PEGASIS is better than that of LEACH in case of load.

5.3 Data Traffic:

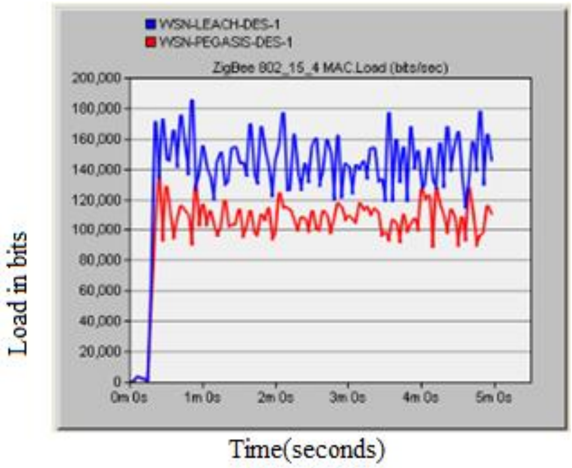

Fig 5.3: Data traffic rcvd(bit/sec)

Fig 5.3 is presenting the Data Traffic Received in the PEGASIS and LEACH protocols. Here, X-axis represents the optimized time and Y-axis represents the delay in bits. In this figure it is clear that the traffic in the network is less in case of PEGASIS as compare to LEACH which is responsible for the load.

VI. CONCLUSION

The energy potency could be a terribly most important issue for the networks significantly for WSNs that area unit represented by "limited battery capabilities". During this paper, the focus on the energy efficient protocols that are developed for WSNs. From the comparison of two protocols it is concluded that PEGASIS is better to reduce energy consumption than LEACH. Therefore, the appliance of the suitable routing protocol can enhance the lifetime of the network and at constant time it will guarantee the network property and effective and economical knowledge delivery.

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