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Energy-Efficient Routing Cluster Protocols for Wireless Sensor Network

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Abstract: Wireless Sensor Networks (WSNs) consist of small nodes with sensing, calculation and wireless communications capability. Many routing, capacity management, and data circulation protocols have been specifically designed for WSNs where energy alertness is an needed method issue. The final development in the wireless network is the main condition for us to choose this topic. The focus has been given to the routing protocols which might differ depending on the application and network architecture. In this paper, we present a analyses of the state-of-the-method routing techniques in WSNs. We first diagram the design challenges for routing protocols in WSNs followed by an exhaustive of some of the routing techniques. Overall, the routing techniques are classified into three categories based on the underlying network structure: flat, hierarchical, and location-based routing .These protocols can be divided into lifetime -based, and Qos-based, depending on the protocol operation. We review the design trade-offs between energy and communication upward savings in some of these routing paradigm. We also mention the advantages and achievement issues of each routing technique.

Keywords: *Sensor Networks; Clustering Routing; LEACH; C LEACH;TL-LEACH, PEGASIS.*

I. Introduction

Wireless Sensor Networks (WSNs) consists of tiny sensors nodes or environmental conditions such as temperature, sound, fluctuation, pressure,gesture at different locations. The evolution of wireless sensor networks was originally inspire by military applications for battlefield neglect. In these situations, it is difficult to replace the dead nodes caused by energy's depletion with new ones to supply energy for the system.,sensor nodes working as deep as possible is the main method to maximize the life cycle of the system. The energy's consumption of sensor node mainly emerge from the long distance transmission of data along the routing path, an efficient routing path formed by the routing protocol will have a great contact on the energy's consumption [3]. So how to design an energy-efficient routing protocol becomes the main goal for the wireless sensor network.Therefore, wireless sensor networks are used in many civilian applications including environmental and home monitoring, health-care applications etc. This network enclose a large number of nodes which sense data from an desperately inaccessible area and send their data toward a processing center which is called "sink". Since sensor nodes are power constrained devices, frequent and long-distance transmissions should be kept to minimum in order to prolong the network lifetime [1] Thus, communication between the sensor nodes and the base station is expensive, and there are no "high-energy" nodes through which communication can proceed. WSN are a widely applicable, major metalise technology. They bring a whole host of novel research challenges refer to energy efficiency, robustness, scalability, self-configuration, etc. These challenges must be take up at multiple levels through different protocols and mechanisms. Present partial solutions offer much hope for the future, but much work remains to be done. The use of clusters for transmitting data to the base station the advantages of small transmit distances for most nodes,compelling only a few nodes to transmit far distances to the base station. However, LEACH show better clustering algorithms by using adaptive clusters and rotating cluster-heads, among all the sensors. In addition, we show LEACH is able to perform local computation in each cluster to reduce the amount of data that must be transmitted to the base station. Clustering routing algorithms are now an active part of routing technology in WSNs due to various advantages, such as more scalable, less load, less energy consumption and more robustness [1][4]. The rest of the paper is organized as follows: Section II provides an overview of the LEACH,LEACH-C, ER-LEACH, PEGASIS, LEACH -SM TL LEACH AND V - LEACH Protocols.In section III, we simulate and compare the protocols. Finally, Section IV concludes this paper.

II. Literature Survey

The report on a Energy Efficient Clustering Protocols for Wireless Sensor Network by analysing the advantages and disadvantages of conventional routing protocols using our model of sensor networks, then developed LEACH (Low-Energy Adaptive Clustering Hierarchy), a clustering-based protocol that minimizes energy dissipation in sensor network.

Different LEACH parameters are studied. Firstly, Allen et al. [17] presented that sensor networks with the ability to have small devices physically distributed near the objects being sensed brings new opportunities to observe and act on the world, for example with micro-habitat monitoring, structural monitoring, and wide-area

environmental systems. After that Effen et .al [16] presented that wireless sensor networks with thousands of tiny sensor nodes and expected to find wide applicability and increasing deployment in coming years as they enabled reliable monitoring and analysis of the environment. This paper proposed a modification to a well-known protocol for sensor called Low Energy Adaptive Clustering Hierarchy). Akyildiz et .al [13], further analyzed that energy conservation have a main priority in all technology and engineering field. Most current applications that consume energy could be customized or optimized in a process resulting less energy consumption. Heinemann et al. [11] presented in underwater sensor networks and highlighted potential applications to off-shore oilseeds for constant monitoring, equipment monitoring, and underwater robotics. Then, Heinemann et al. [10] analyzed networking of hundreds or thousands of cheap micro sensor nodes and allowed users to accurately monitor a remote environment by intelligently combining the data from the individual nodes. Heinzelman et al. [9] proposed that the Hybrid Energy Efficient Distributed protocol for the heterogeneous wireless sensor network W. Heinzelman et al.[8] presented wireless sensor networks with thousands of tiny sensor nodes that expected to find wide applicability and increasing deployment in coming years, as they enable reliable monitoring and analysis of the environment.Balakrishna et al. [7] presented a growing interest in wireless sensor networks. The hot point in these algorithms was the cluster head selection. Rabiner et al. presented [6] that the energy conservation had a main order in all technology and engineering field. Handy et al. [5] presented wireless distributed micro sensor systems which invest the reliable monitoring of a variety of environments for both civil and military applications. V.Mhatre et al. [4] focused on reducing the power consumption of wireless micro sensor networks.Manjeshwar et al. [3] presented a formal classification of sensor networks, based on their mode of functioning, as proactive and reactive networks. Reactive networks, as opposed to passive data collecting proactive networks. Hssane et al. [2] presented wireless sensor network (WSN) which was a power constrained system, since nodes run on limited power batteries which shorten its lifespan. Kumar et al. [1] presented hybrid energy efficient distributed protocol for the homogeneous wireless sensor network. The main requirements of wireless sensor network were to prolong the network lifetime and energy efficiency.

III. Leach Protocols

A. Brief Description

LEACH, an application-specific protocol develop. The application that normal micro sensor networks mean the monitoring of a remote environment. Since living nodes' data are related in a sensor network, the end user does not require all the redundant data; rather, the end user needs a high-level purpose of the data that show the events appearing in the environment. Because the correlation is capable between data signals from nodes located close to each other, we chose to use a clustering infrastructure as the basis for LEACH. This confess all data from nodes within the cluster to be processe locally, reducing the data set that needs to be transmitted to the end user. In particular, data aggregation methods can be used to combine several related data signals into a smaller set of information that maintains the compelling data (i.e., the information content) of the original signals. Therefore, much less actual data needs to be transmitted from the cluster to the base station (BS).

LEACH may be better when these assumptions do not hold. In LEACH, the nodes classify themselves into local clusters, with one node acting as the cluster head. All non-cluster head nodes transmit their data to the cluster head, while the cluster head node receives data from all the cluster members, performs signal processing part on the data (e.g., data aggregation), and transmits data to the remote BS. LEACH Low-Energy Adaptive Clustering Hierarchy (LEACH) was proposed by Heinzelman [5] and is one of the first clustering routing algorithms proposed for WSNs. LEACH was originally for wireless micro-sensor networks. LEACH is based on a clustering infrastructures, as all the data is handled in the cluster locally and only limited data is sent to the end user

B. LEACH-C

LEACH-Centralized [6] is an advancement of LEACH, it uses the variable steady state protocol as of LEACH but, uses a consolidate clustering algorithm for cluster formation. During the set up phase all the nodes transmits its area and energy level to the BS and then the BS decides which nodes should be CH and which nodes should combine to which CH. After this the BS broadcasts a message containing the CH ID for each node, if it accept its own ID it knows it is the CH. LEACH-C and LEACH have the same steady state phase.

C. TL-LEACH

The cluster formation protocol is a local process that recognise, a two-level hierarchy .In this way each node can decide to result in a good cluster. The use of two-levels of clusters for transmitting data to the base stations leverages the advantages of small transmit distances for more nodes more than in the beginning LEACH. In this way less nodes are required to transmit far distances to the base station and it is especially true in networks where the density of nodes is high. The use of clusters for transmitting data to the base station

advantages of small transmit distances for most nodes, involving only a few nodes to transmit far distances to the base station.

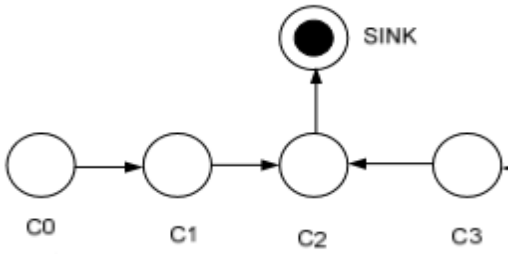

Fig 2 Token Passing Scheme

D. V-Leach

V-LEACH protocol, the cluster contains; CH (responsible only for sending data that is received from the cluster members to the BS), vice-CH (the node that will become a CH of the cluster in case of CH dies), cluster nodes (gathering data from environment and send it to the CH .In the newest LEACH, the CH is always on receiving data from cluster members, combined these data and then send it to the BS that might be located far away from it. The CH will die previous than the other nodes in the cluster because of its operation of receiving, sending and overhearing. When the CH die, the cluster will become worthless because the data gathered by cluster nodes will never reach the base station. In V-LEACH protocol,likewise having a CH in the cluster, there is a vice-CH that takes the role of the CH when the CH dies because the reasons we show above by doing this, cluster nodes data will always reach the BS; no need to elect a new CH each time the CH dies.me.

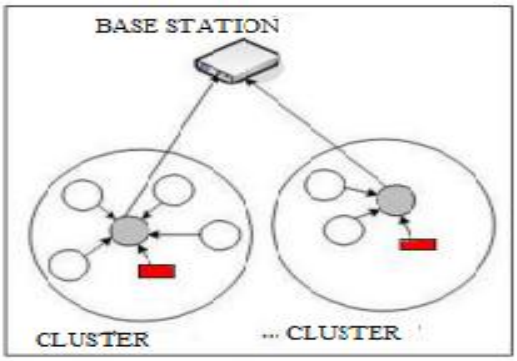

Fig.3 V -LEACH PROTOCOL

The main issue with LEACH protocol lies in the random selection of cluster heads. There exists a probability that the cluster heads formed are unbalanced and may remain in one part of the network making some part of the network unreachable. This problem is resolved by using the concept of V-Leach. V Leach uses the concept of alternate Cluster Head called Vice Cluster Head and finally the network dies completely.

E. PEGASIS

Power-Efficient Gathering in Sensor Information Systems (PEGASIS) [7] is an improved version of LEACH. The goal of PEGASIS is that the node discourse to the other nodes in its organise and the nodes take turns to become a CH. It only selects one node as a CH to send data to the BS in each round. Each node compare with its close next door neighbors and takes turns to correspond with the BS.

• **Phase 1:** Chain Construction: Starting from the node furthest from the BS the chain is constructed using a greedy algorithm, the chain formation can be adept by the sink or the nodes itself.

• **Phase 2:** Data gathering and Transmission to BS: One node is selected as the CH randomly that communicates with the BS. When a node dies in the network a new chain is formed by passing the dead node. The CH receives all the fused data from the Sensor Node (SN) and sends it to the Base Station (BS). Data transmission in PEGASIS.

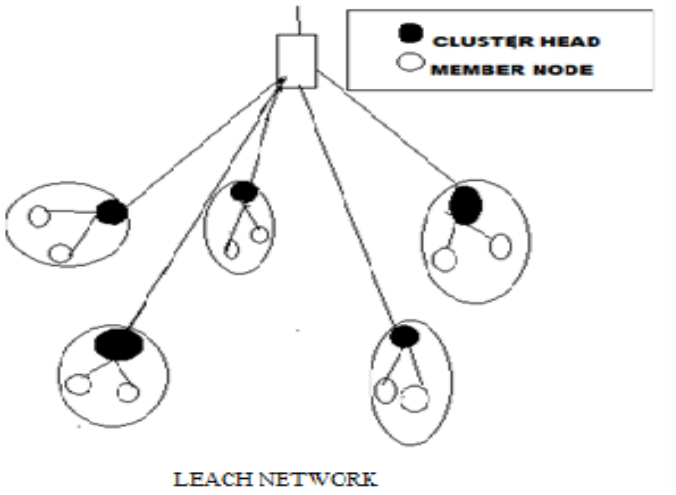

FIG. 4 LEACH NETWORK

F. Efficient-Routing Leach (ER-LEACH)

Efficient Routing LEACH (ER-LEACH) [3] which is a modified version of the well-known LEACH protocol.There are three contributions in this protocol which are upgrading the selection of the cluster head during setup phase by taking into account the residual energy of any sensor node which intends to become a CH to prolong the network lifetime. The second contribution is trying to reduce the overhead of dynamic clusters generation by using alternative CH which is expected to take the role of the CH in case that the underlying CH died which will prolong the lifetime of each cluster, and finally for the sake of load balancing the zone routing protocol is used which attempts to balance the load over CHs evenly by permitting the CH to discover the optimal route to the BS with less cost messages update and then sends the fused data to the BS through many other CHs instead of direct sending to the BS. ER-LEACH is normal to perform well especially when the mobility is very high and will prolong the overall network lifetime through load balancing

G. Leach – Spare Management (LEACH-SM)

LEACH-SM protocol [5] modifies LEACH by enhancing it with an efficient management of spares. It is also designed for static sensor nodes and static targets. LEACH-SM contract with both energy-consumption in efficiencies of LEACH. LEACH-SM adds a phase, called the spare selection phase.

IV. Comparison Of Leach,Leach-C, Er-Leach, Pegasis, Leach -Sm Tl Leach And V - Leach

There are many techniques available for data evaluation such as real-life measurements, analytic modeling and software simulations. For real-life measurements we will require hardware to set up a wireless sensor network. This is not a feasible method for data evaluation as we usually want to acquire data for hundreds of nodes and to setup such a large network can be a time and money consuming task. The second method which involves formulating mathematical equations for the network. This also is a very heavy task as it will involve a lot of time consuming and clear calculations. So we will use simulation using Network Simulator-2 (NS-2) [8] to imitate the behavior of a WSN.

A.Throughput

To represent the throughput of each protocol we use data received at the BS with respect to time and energy dissipation. LEACH-C performs 20% better than LEACH due to the built up computation by the BS to find better clusters. LEACH-C successfully delivers more data to the BS than LEACH with respect to both time and energy. Hence proving that LEACH-C has a higher throughput than LEACH..PEGASIS performs better than both LEACH and LEACH-C. PEGASIS performs 260% better than LEACH and 200% better than LEACH-C.TL LEACH performs better than LEACH, LEACH-C and PEGASIS..In TL LEACH throughput (data signals received at the BS) .

B.Network Lifetime

To represent network lifetime we will compare the nodes alive of each protocol to time and data received at BS. PEGASIS sends multifold data to the BS in comparison to LEACH or LEACH-C.PEGASIS

deliver the most data per unit energy followed by LEACH-C and then than LEACH, hence PEGASIS achieves both energy efficiency and latency efficiency but TL LEACH achieve density of nodes is high .

LEACH is not as efficient as LEACH-C or PEGASIS (LEACH-C delivers about 20% and PEGASIS delivers more than 250% data per unit energy than LEACH respectively). The reason for this is that in LEACH-C the BS has global information of the position and energy of the other nodes, due to it can create enhanced clusters that need lesser energy for transmission. PEGASIS outperforms LEACH and LEACH-C as it removes the overhead of dynamic cluster information, PEGASIS also minimizes the sum of distances and restrict the number of transmissions, but TL LEACH require less nodes to transmit far distances to the base station ,network lifetime of TL LEACH (number of nodes alive over time).

C.Energy Consumption

As LEACH-C is able to send more data packets per unit energy consumed which confirm that LEACH-C performs better than LEACH in terms of energy consumption. PEGASIS consumes the least energy to per data packet sent to the BS and behave the best and hence is the most energy efficient. In TL LEACH we do not assume any constant energy dissipating nor do we remove energy during carrier-sense operations.

D. CH Selection

In clustering head selection of LEACH and V -LEACH is arbitrary,C - LEACH CH Selection done by BS based on energy.T-L LEACH is also based on energy.In ER-LEACH CH Selection based on Energy decided with in the cluster and at last LEACH -SM , during the cluster setup phase ,each node decided in lateral whether should become in active primary node or passive spare node.In PEGASIS data gathering and Transmission done by BS on each node correspond with its close next door neighbors and takes turns to correspond with the BS.

E. Data Transmission

In LEACH and C LEACH both are all CH sends directly to BS.In V - LEACH Vice CH takes over CH in case CH dies,ER-LEACH if the base station is not within range of CH ,it routed the CH in case of deadhead and LEACH SM the passive spare nodes goes to asleep where the data is transmitted through the primary active node.

F. Mobility

The mobility of LEACH ,C LEACH and V LEACH is stationary but ER-LEACH refers to mobile and SM-LEACH designed for static sensor nodes and static targets.

V. Routing Challenges And Design Issue In Wsns

The design of routing protocols in WSNs is formed by many demanding factors. These factors must be efficient communication can be achieved in WSNs.

A. Node deployment

Node deployment in WSNs is application debased and modify the performance of the routing protocol. The performance can be either deterministic or randomized. In deterministic deployment, the sensors are annually placed and data is routed through pre-determined paths. However, in odd node deployment, the sensor nodes are dispersed randomly creating an infrastructure in an ad hoc manners. Therefore, it is most likely that a route will consist of multiple wireless hop.

B. Energy consumption without losing accuracy

Sensor nodes can use up their limited supply of energy operating computations and transmitting information in a wireless environment. As such, energy sustain forms of communication. In a multihop WSN, each node show a dual role as data sender and data router.

C. Data Reporting Model

Data sensing and reporting in WSNs is a based on the application and the time essential of the data reporting. Data reporting can be classified as either time-driven ,event-driven, query-driven, and hybrid.The time-driven require periodic data monitoring. Sensor nodes will periodically switch on their sensors and transmitters, sense the environment and transmit the data of relevance at steady periodic time intervals.

D. Fault Tolerance

Some sensor nodes may fail or be blocked due to lack of power or environmental interference etc. The deficit of sensor nodes should not affect the overall task of the sensor network. If various nodes fail, MAC and

routing protocols must involve formation of new links and routes to the data collection base stations and require adjusting transmit powers and signaling rates on the existing links to reduce energy consumption. Therefore, various levels of redundancy may be needed in a fault-tolerant sensor network.

E. Scalability

The number of sensor nodes deployed in the sensing area may be in order of hundreds or thousands or many Any routing scheme must be able to work with this large number of sensor nodes. In addition, sensor network routing protocols should be expansible to respond to events in the environment. Until most of the sensors can remain in the sleep state with data from the few remaining sensors providing a quality.

F. Network Dynamics

Most of the network architectures assume that sensor nodes are static. However, mobility of both BS's or sensor nodes is sometimes need in many applications.Routing messages from or to moving nodes is more impose. Since route stability becomes a important to energy, bandwidth etc.

VI. Conclusions

In this paper,Wireless sensor networks consists of thousands of tiny, low cost, low power and multifunctional sensor nodes where each sensor node has very low battery life. Various energy efficient algorithms have been designed for this. LEACH uses distributed cluster formation & randomized rotation of the cluster head to minimize the network energy consumption. This paper proposes a new version of LEACH protocol called V LEACH protocol,there is less number of dead nodes,Number of alive nodes is enhanced, Based on our MATLAB simulations described above, we are confident that LEACH will outperform conventional communication protocols, in terms of energy dissipation, ease of configuration, and system lifetime / quality of the network.The proposed work improvement over the V-Leach; in this proposed work we are trying to improve the network life., initially when the cluster heads are selected based on the energy and the distance parameters; we also select the Vice Cluster Head. LEACH show better clustering algorithms by using adaptive clusters and rotating cluster-heads, among all the sensors. In addition, we show LEACH is able to perform local computation in each cluster to reduce the amount of data that must be transmitted to the base station.,routing technology show in WSNs due to various advantages, such as more scalable, less load, less energy consumption and more robustness

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