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Performing Efficient protocol for reducing energy consumption in wireless sensor Networks

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Abstract

Wireless Sensor Networks (WSN) are one of the most rapidly developing technologies with a wide range of applications which includes a sensing process, security providence and environmental sensing and military applications. WSN consists of collection of sensor nodes and each sensor nodes are used for sensing the environmental conditions while transmitting data to the base station. Energy consumption is the major issue in WSN. Each sensor nodes can utilize only limited amount of power supply for performing transmission of packets in a wireless environment. In this paper, we study the various routing protocols and compare among them. We also study the trade-offs between energy and communication overheads, highlighting the advantages and demerits of each routing protocol with the purpose of discovering new research Directions. Based On The Identified ResearchGap,WePropose An Optimum Energy Efficient Routing Protocol For Today's Wsns. Clustering is one of the promising techniques for reducing the energy consumption. In a clustered WSN, sensor nodes are partitioned into a certain number of clusters, each of which has a cluster head (CH) and some non-cluster head members. CH collects information from all the cluster members and then forwards to other CH. while non-CHs are responsible for sensing environmental conditions and transmitting information to the corresponding CH. The simulation results show how the election criteria for cluster heads election such as random election and nodes with different energy level affect the number of cluster heads elected, and the network lifetime. In this paper, we analyse three different types of routing protocols: LEACH, SEP, and TEEN. Simulation results are provided to show the comparative effectiveness of different clustering algorithm on network lifetime and cluster head selection and failure nodes in the network. Sensor networks are simulated using MATLAB simulator.

Keywords **-** Wireless sensor network, TEEN, LEACH, SEP, network- lifetime, Cluster Head, Energy Efficiency, Routing Protocols.

Problem Statement

The Fundamental function of a sensor network is to sense and forward packets to the desired destination or end system, without losses. The end system could be a base station positioned in a remote environment. In the event of energy constraint in a sensor network, routing protocol is then used to tract and identify the path to the destination.

The established path then enables the nodes in sending and receiving data. Where the sensed data is only available to particular segments that are unable to forward it to the desired destination due to energy constraint or depletion in the sensor nodes in those segments.

II. Literature Review

Routing Protocols are classified based on network structure and Mode of Operation.

Data Centric Routing

This protocol employs the sink to forward queries to particular segments or regions of the network and waits for an acknowledgement reply. Since global addressing is to each node impossible, energy is conserved through data aggregation, correlation and elimination of redundant data.

Sensor Protocol for Information via negotiation (Spin)

In this protocol, data and high level descriptors are employed for data transmission by exchanging the data among sensors through a data advertisement mechanism. Spin offers the advantage of localizing topological changes in the network, as a node is required to know only its single-hop neighbours. The main drawback of SPIN is that the advertisement mechanism is prone to Best- effort-delivery of Data.

Minimum Cost Forwarding Algorithm (Mcfa)

The main objective of this protocol is to stablish the cost field through routing, and transmit the data through the minimum-cost path. The energy consumption, the battery life and hop count all follow the minimum cost path criteria. A node routes its cost to the destination which broadcasts an ADV Message. The receiving node then broadcast to its neighbour adding the cost in ADV to its own cost, and the cost field is set up in the process. It has the advantage of simplicity as there is no need to maintain a forwarding table. Also the ID for a neighbour node need not be known. It however has the disadvantage of imbalanced load and limited network size.

Hierarchical Routing

This is mainly a two-layer routing characterized by cluster heads Selection in which nodes play
different roles with focus on scalability and communication efficiency.

Energy Efficient Cluster Based Routing Protocols

Hierarchical routing performs energy-efficient routing in WSNs, and contributes to overall system scalability and lifetime. In a hierarchical architecture, sensors organize themselves into clusters and each cluster has a cluster head, i.e. sensor nodes form clusters where the low energy nodes are used to perform the sensing in the proximity of the phenomenon. The less energy constrained nodes play the role of cluster-heads and process, aggregate and forward the information to a potential layer of clusters among themselves toward the base station. In this section, we introduce three cluster based scheduling mechanism.

Low-Energy Adaptive Clustering Hierarchy (Leach)

This is based on the formation of clusters of the sensor nodes in accordance with the received signal strength, and employing local cluster heads as routers to the destination. This is followed by Stochastic change in the cluster heads in order to balance the energy dissipation of nodes following This model :

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$$Pi(t) = \frac{K}{(N-K)*rmod(\frac{n}{K})} \quad : Ci(t) = 1$$

$$= 0 \quad : Ci(t) = 0$$

Here r is number of rounds have passed and Ci (t) = 0. N is totalling number of nodes in the network and k is optimal number of cluster head. There are two phases in this protocol-setup phase and steady state phase. The clusters are organized and their heads are selected in the setup phase while the data are transported to the base station in the steady state steady phase. LEACH has the advantage of improved performance in terms of energy dissipation, configuration efficiency and sustained battery life in relation to conventional communication systems. However, LEACH is not suitable for networks that are deployed in large regions because of its employment of single-hop routing where individual node directly transmit to the Cluster-Head and the destination. A sensor network is a collection of communicating sensing devices. These devices communicate wirelessly to transmit their readings and widely known as wireless sensors. A sensor network is collection of such communicating devices. When large number of sensors can be spread across a geographical area and networked in applications then it is termed as wireless sensor network. Clustering is a technique that is used to enhance the lifetime of the sensor network by reducing energy consumption. This paper provides experimental performance evaluation of existing routing algorithm for wireless sensor network. This paper considers the following protocols are organize sensor network into energy efficient algorithm for simulation studies.

SEP (Stable Election Protocol)

When there are heterogeneous nodes present in any network this protocol improves on election of cluster head. In this nodes of different energy levels are considered. In heterogeneous application the election probability of becoming the cluster head will depend on the type of existing nodes in presence of m fraction of advance node with additional energy of factor α [3]. Weighted probability for normal and advance node is given by:

For normal node:

$$Pnrm = \frac{PoPt}{1+\alpha,m}$$

For advance node:

$$Padv = \frac{POPt}{1+\alpha,m} * (1+\alpha)$$

Where pnrm and padv are probability of normal node and advance node.

TEEN (Threshold sensitive energy Efficient sensor network protocol)

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It's a hierarchical protocol designed to respond to sudden changes in the sensed attributes. It uses data centric mechanism. In this hierarchical grouping is being done. Where closer M nodes form clusters and this process goes on until the sink is reached. After clustering is done, the cluster head broadcasts two thresholds to the nodes- the hard and the soft threshold. TEEN is important for time-critical applications, in which the network is operated in a reactive mode. TEEN uses a data-centric method with hierarchical approach. The sensor network architecture in TEEN is based on a hierarchical grouping where closer nodes form clusters and this process goes on the second level until the sink is reached.

TABLE 1 . COMPARISON OF ENERGY EFFICIENT ROUNTING PROTOCOL .

Protocols	Network Type	Application	Cluster head Selection
LEACH	Proactive network	fault detection and diagnosis	Random , Dynamic Election
SEP	Proactive network	Similar	Scalable and dynamic , Presence of advance node
TEEN	Reactive Network	Time critical	Based on Two threshold value

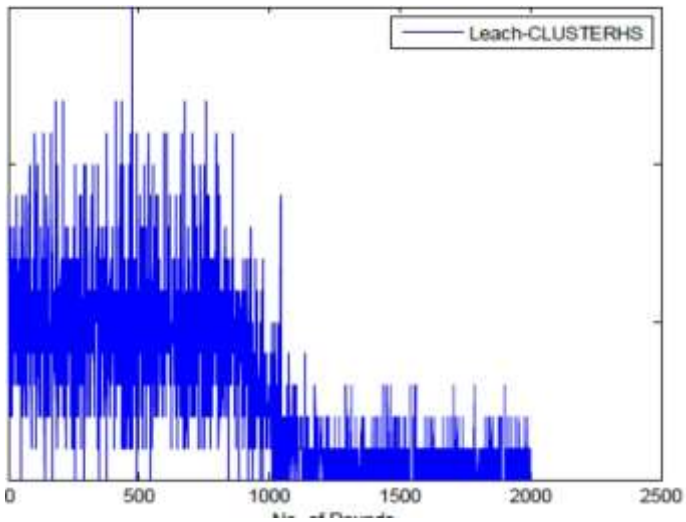

Fig : 01 Elected Cluster Head LEACH.

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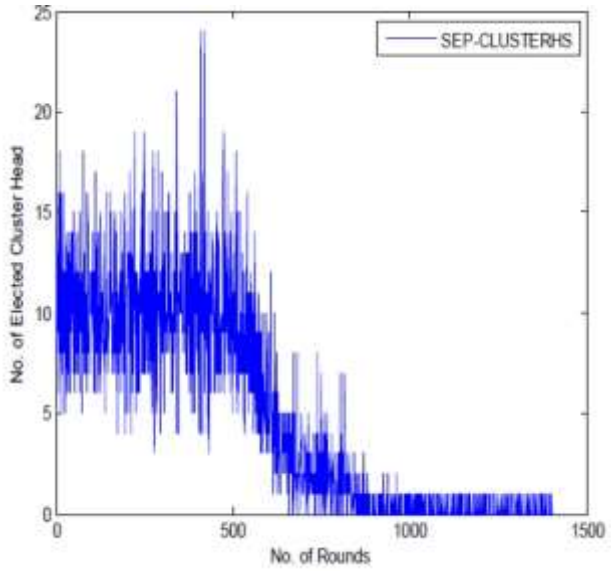

Fig : 02 Elected Cluster Head in SEP.

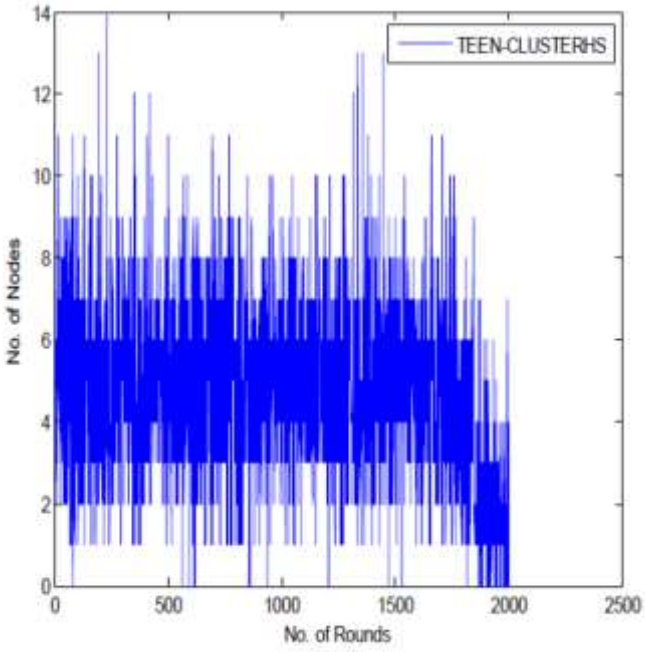

Fig :03 Elected Cluster Head In TEEN.

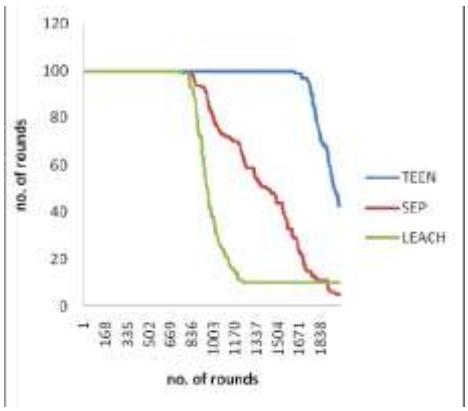

Fig 4: Network Life Time in Leach, SEP and Teen Heterogeneous Environment with respect to total no.of round.

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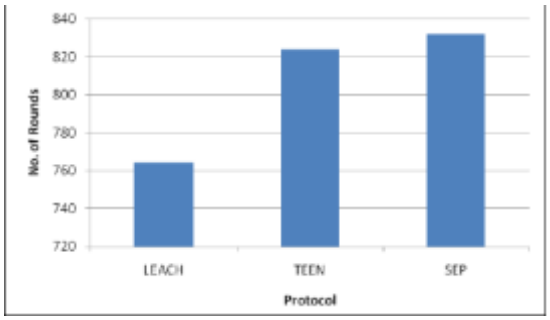

Fig 5: Network Life Time (Stability) of Leach , TEEN and SEP

Sensor networks are simulated using MATLAB simulator. To evaluate the performance of the clustering routing protocols in wireless sensor network the simulation consists of 100 nodes with initial energy of 0.5 joule, scattered randomly within a 100 m sensor field. The base station is (BS)located at (50,300)m, 5000 Packet length and 50 bit control packets. The energy consumption due to communication will be calculated using the first order energy model. We assume that each sensor node generates one data packet per time unit to be transmitted to the BS. For simplicity, we refer to each time unit as a round.

Performance Matrices Used In Simulation

4.1 Elected cluster Head per Round

The election of Cluster head is lies on various parameters like Initial energy Eo, probability p. In probabilistic clustering technique, nodes are selected to become the cluster head depending on calculated probability . We change in the parameters for cluster heads election in the above three protocols. Then by simulation result we will show the variation in the results.

4.2 Network Lifetime

If the protocol can completely utilize the presence of some advance nodes that have extra energy to increase network lifetime then it will be very beneficial. The lifetime can be defined either the number of rounds until the first nodes dies or a certain percentage of nodes are dies. Simulation is performed by varying the fraction of m advance nodes with the constant extra energy .The comparisons for the three protocols are further analysed and the results are shown in Figure 4. It can be seen that, the presence of advanced nodes gives no effect to LEACH and TEEN protocol while the network lifetime improves SEP protocols.

5. Simulation Results

The simulation results for LEACH, SEP and TEEN protocols are shown in Figures 1,2,3. It is observed that there are distinct variations in the number of cluster heads elected per round for all three protocols as shown in Figures 1, 2, 3. In LEACH and TEEN protocols, the optimal number of cluster heads is set to 5% . It can be seen that the variation of number of cluster heads for LEACH and TEEN protocols which is far from near optimal, 5. In SEP protocol, the optimal number of cluster heads is 10 due to the presence of advanced node . The variation of number of cluster heads. This means, the SEP protocol manages to minimize the variation in the number of cluster heads elected. The comparison for the three protocols are further analysed and the results are shown in Figure 4. It can be seen that, the presence of advanced nodes gives no effect to LEACH and TEEN protocol while the network lifetime improves SEP protocols. Simulation result for this are as follows: As stability factor SEP is better than other two LEACH and TEEN because First node dead (FND) at 832,824 and 764 round in SEP, TEEN and LEACH which is show in Figure 5.

6. conclusion

In this paper, it is analyzed energy efficient three protocols LEACH, TEEN and SEP clustering algorithms for heterogeneous wireless sensor network. The simulation results show how the election criteria for cluster heads election such as Initial Energy Eo, probability with presence of advance nodes with different energy level and base station area affect the number of cluster heads elected, and the network lifetime .Simulation results are provided to show the comparative effectiveness of different clustering algorithm on network lifetime, cluster heads selection. We have evaluated the performance of LEACH, TEEN and SEP using MATLAB.

Table 2: Simulation Summary

Protocol	Elected Cluster Head Heterogeneous network	FND IN ROUNDS (First Node In Rounds)	Life Time
LEACH	**13 (Variations)**	**764**	**Comparatively less**
SEP	**24 (Variations)**	**832**	**Comparatively Best**
TEEN	**14 (Variations)**	**824**	**Comparatively Better**

It is observed that there is significant improvement in the lifetime in case of SEP protocol in comparison with LEACH and TEEN protocols because the number of rounds is maximum i.e. SEP is more stable because FND at 834 round which is maximum as compare to LEACH and TEEN values of which are 764 and 824 round. Simulation summary shows in Table 2.

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