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Analysis of Energy Efficient Clustering Method Using Leach Protocol for Improving Network Performance in Wireless Sensor Networks Advanced Research Used in Computer Science and Electronics Engineering

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Abstract: - Wireless sensor network is scalable and has a capacity to reduce energy consumption. Wireless sensor technology has a great impact now days. Clustering is a network management technique. The batteries on today's wireless sensor barely last a few days, and nodes typically expend a lot of energy in computation and wireless communication. Hence, the energy efficiency of the system is a major issue at each neighborhood; one sensor shares its raw data as a reference with the rest of sensors. It creates a hierarchical structure over a flat network. Clustering technology in access points is advanced intelligence that allows them to work together dynamically as a "configuration-aware group."

Keywords: TDMA, LEACH, DEECIC

I. CLUSTERING

Clustering is very important to reduce energy consumption .Clustering is an important mechanism in large multi-hop wireless sensor networks for obtaining scalability, reducing energy consumption and achieving better network performance.

Most of the research in this area has focused on energy-efficient solutions, but has not thoroughly analyzed the network performance, e.g. in terms of data collection rate and time.Wireless sensor networks in the cluster algorithm use multi-hop style of communication, close to the sink node of the cluster head node transmit a lot of data which led to excessive energy consumption, the node is easily failure, finally network partitioning.

Quite a lot of node clustering techniques have appeared in the literature, and roughly fall into two families: those based on the construction of a dominating set and those which are based solely on energy considerations as shown in figure1. The former family suffers from the fact that only a small subset of the network nodes are responsible for relaying the messages, and thus cause rapid consumption of the energy of these nodes.

The latter family uses the residual energy of each node in order to decide about whether it will elect itself as a leader of a cluster or not. This family's methods ignore topological features of the nodes and are used in combination with the methods of the former family.

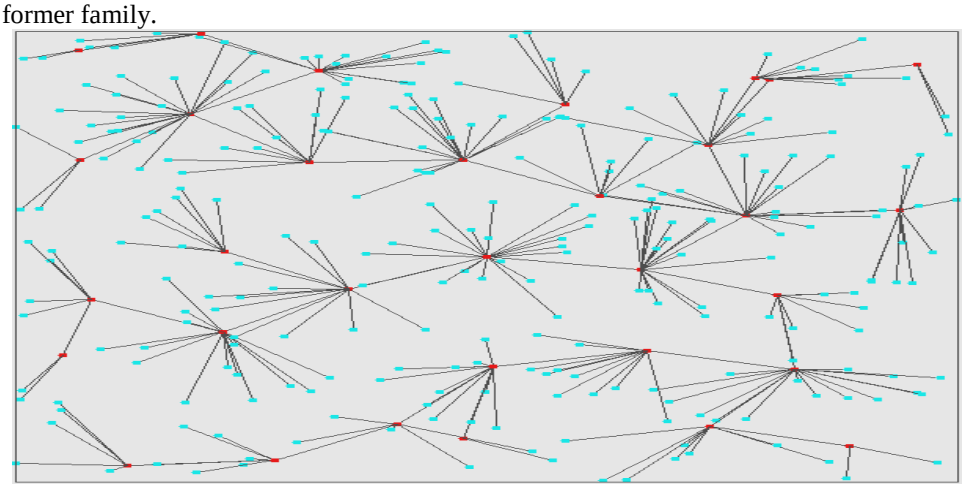

Figure1 Different types of Routing Protocols

Sensing rate for all sensors fixed

Energy Consumption

Theoretical background

Radio model: The radio model is showed in Figure 2

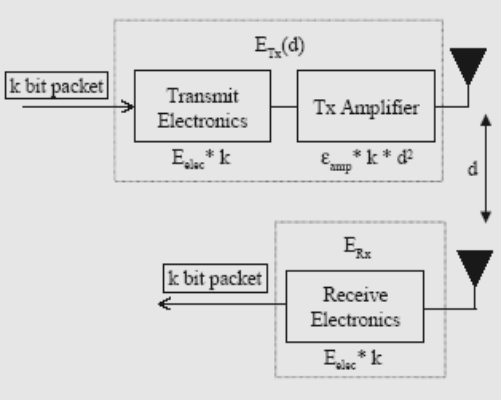

Figure 2 Radio model for WSN

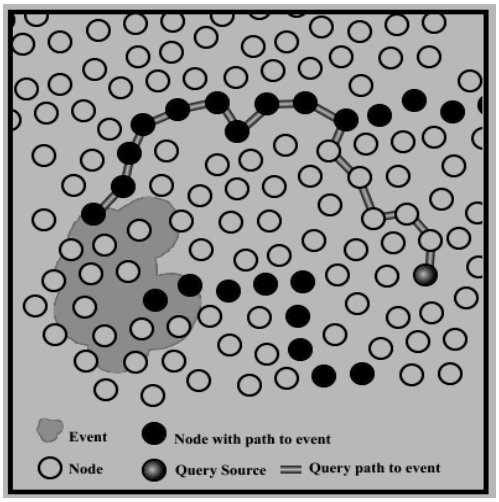

Figure 3: Energy consumption formula for receiving a k-bit message

Sensor board, CPU board, and Memory board: These boards work in 2 modes: full action and sleep. In the sleep mode, the energy dissipation is almost zero [1]
Different types of protocols

(a) LEACH

(1) It is designed for sensor networks where an end-user wants to remotely monitor the environment. In such a situation, the data from the individual nodes must be sent to a central base station, often located far from the sensor network, through which the end-user can access the data.
(2) Conventional network protocols, such as direct transmission, minimum transmission energy, multi-hop routing, and clustering all have drawbacks that don't allow them to achieve all the desirable properties.
(3) LEACH includes distributed cluster formation, local processing to reduce global communication and randomized rotation of the cluster-heads [2] .There are several desirable properties for protocols on these networks:

1. Use 100's - 1000's of nodes
2. Maximize system lifetime
3. Maximize network coverage
4. Use uniform, battery-operated nodes

(4) Together, these features allow LEACH to achieve the desired properties. Initial simulations show that LEACH is an energy-efficient protocol that extends system lifetime.

(b) SPIN

(1) It is a family of protocols used to efficiently disseminate information in a wireless sensor network. Conventional data dissemination approaches like flooding and gossiping waste valuable communication and energy resources sending redundant information throughout the network. In addition, these protocols are not resource-aware or resource-adaptive.
(2) SPIN solves these shortcomings of conventional approaches using data negotiation and resource-adaptive algorithms. Nodes running SPIN assign a high-level name to their data, called *meta-data*, and perform meta-data negotiations before any data is transmitted. This assures that these are no redundant data sent throughout the network [3].
(3) In addition, SPIN has access to the current energy level of the node and adapts the protocol it is running based on how much energy is remaining. Simulation results show that SPIN is more energy-efficient than flooding or gossiping while distributing data at the same rate or faster than either of these protocols.

II. LEACH PROTOCOL

(1) LEACH is a hierarchical protocol in which most nodes transmit to cluster heads, and the cluster heads aggregate and compress the data and forward it to the base station (sink). Each node uses a stochastic algorithm at each round to determine whether it will become a cluster head in this round [4].
(2) Nodes that have been cluster heads cannot become cluster heads again for *P* rounds, where *P* is the desired percentage of cluster heads. Thereafter, each node has a 1/*P* probability of becoming a cluster head in each round. At the end of each round, each node that is not a cluster head selects the closest cluster head and joins that cluster. The cluster head then creates a schedule for each node in its cluster to transmit its data.
(3) All nodes that are not cluster heads only communicate with the cluster head in a TDMA fashion, according to the schedule created by the cluster head. They do so using the minimum energy needed to reach the cluster head, and only need to keep their radios on during their time slot [5].
(4) LEACH also uses CDMA so that each cluster uses a different set of CDMA codes, to minimize interference between clusters.

III. DATA GATHERING

(1) Data gathering is a common but critical operation in many applications of wireless sensor networks. Innovative techniques that improve energy efficiency to prolong the network lifetime are highly required. Clustering is an effective topology control approach in wireless sensor networks, which can increase network scalability and lifetime.
(2) In this paper, we propose a novel clustering schema EECS for wireless sensor networks, which better suits the periodical data gathering applications. Our approach elects cluster heads with more residual energy through local radio communication while achieving well cluster head distribution; further more it introduces a novel method to balance the load among the cluster heads [6].
(3) Coverage preservation, unique ID assignment and extension of network lifetime are important features for wireless sensor networks. Grouping sensor nodes into clusters is an effective way to improve the network performance. By analyzing communication energy consumption of the clusters and the impact of node failures on coverage with different densities, we propose a DEECIC (Distributed Energy-Efficient Clustering with Improved Coverage) algorithm [7].
(4) DEECIC aims at clustering with the least number of cluster heads to cover the whole network and assigning a unique ID to each node based on local information. In addition, DEECIC periodically updates cluster heads according to the joint information of nodes' residual energy and distribution. The algorithm requires neither time synchronization nor knowledge of a node's geographic location. Simulation results show that the proposed algorithm can prolong the network lifetime and improve network coverage effectively.

IV. CLUSTERING IMPROVEMENTS

Using clustering access points can impact your bottom-line in three ways:
(1) Reduces operations costs by saving hours of (internal or outsourced) technical staff time. Setup requires configuring only one of the access points—it will push the configuration to all the clustered devices. Configure one, and you are done. The cluster also makes management very efficient. A single point of administration—a computer with a web connection—can manage all the access points in the cluster.
(2) Increases security and reduces risk**.** The clustering technology in the Cisco AP541N Wireless Access Point can centralize and share Secure Set Identifiers (SSIDs), encryption settings, administrator passwords, access lists, and MAC address filters to provide robust security for the company data, customer records, and other business assets that users send and receive over your wireless network.
(3) Increases productivity by improving roaming**.** Clustering allows mobile users to roam between the access points, with such a fast handover that their laptop or Wi-Fi phone does not disconnect. IP voice calls can continue without interruption when employees roam from one clustered access point to another.

Energy Considerations

Few points regarding energy

(a) Fixed and remote base station
(b) Nodes homogeneous and energy constrained
(c) Radio channel is symmetric

$$E_A - E_B = E_B - E_A$$

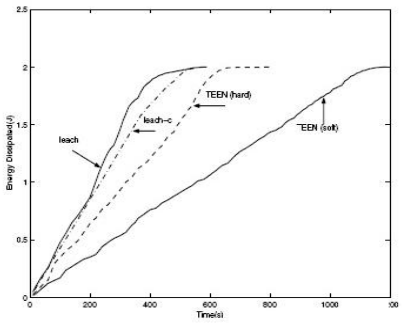

Figure 4. Energy consumption in case of Leach protocol

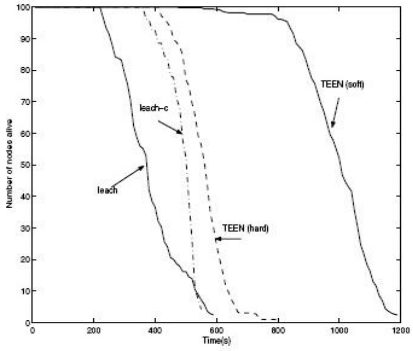

Figure5. Different types of alive nodes in case of leach protocol

V. CONCLUSION

Clustering resolves squabbling between access points over wireless radio band channels. Standalone access points independently select their channel frequency, without coordinating with neighboring access points. The result is overlapping channels and congestion that cause radio signal interference and slower data transmissions. Clustering can help ensure that each access point checks the channels being used by its neighboring access points and adjusts. Clustering intelligence makes it easy to set up, configure, and manage multiple wireless access points, without the need to invest in a wireless controller unless your business requires more advanced wireless applications. A controller based on today's Wireless-N (802.11n) technology is a powerful management device and a significant expense.

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