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Effective Energy Depletion in Wireless Sensor Network using EEDC Technique

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***Abstract*-This work is to build an energy efficient and power aware technique so as to prolong the wireless sensor network lifetime. In the development of various large-scale sensor systems, a particularly challenging problem is how to dynamically organize the sensors into a wireless communication network and route sensed information from the field sensors to a remote base station. A new energy-efficient dynamic clustering technique for large-scale sensor networks is proposed. By monitoring the received signal power from its neighboring nodes, each node estimates the number of active nodes in real time and computes its optimal probability of becoming a cluster head, so that the amount of energy spent in both intra and inter-cluster communications can be minimized.**

***Keywords*- Wireless sensor network, Dynamic clustering, MAC Protocol, Dijikstra's algorithm**

I. Introduction

Wireless sensor network (WSN) is a wireless network consisting of spatially distributed autonomous devices using sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants, at different locations. The development of wireless sensor networks was originally motivated by military applications such as battlefield surveillance. However, wireless sensor networks are now used in many industrial and civilian application areas, including industrial process monitoring and control, machine health monitoring, environment and habitat monitoring, healthcare applications, home automation, and traffic control. Each node in a sensor network is typically equipped with a radio transceiver or other wireless communications device, a small microcontroller, and an energy source, usually a battery. Sensor nodes can be imagined as small computers, extremely basic in terms of their interfaces and their components. They usually consist of a processing unit with limited computational power and limited memory, sensors (including specific conditioning circuitry), a communication device (usually radio transceivers or alternatively optical), and a power source usually in the form of a battery.

II. Dynamic And Static Clustering

Routing messages from or to moving nodes is more challenging since route stability becomes an important optimization factor, in addition to energy, bandwidth etc. The sensed event can be either dynamic or static depending on the application. For instance, in a target detection/tracking application, the event (phenomenon) is dynamic whereas forest monitoring for early fire prevention is an example of static events. Monitoring static events allows the network to work in a reactive mode, simply generating traffic when reporting. Dynamic events in most applications require periodic reporting and consequently generate significant traffic to be routed to the sink.

A large-scale sensor network consists of a large number of small, relatively inexpensive and low-power sensors that are connected as a wireless network, through which the data extracted from the sensor nodes are sent to a remote base station (BS). The networking protocols must scale well to a large number of nodes, adapt to a dynamic network environment, and be energy efficient as well as power-aware. By energy-efficient, we mean that the energy spent on delivering packets from a source to a destination is minimized. By power-aware, we mean that a route with nodes currently having higher remaining battery power should be selected.

III. Related Work

The clustering methods in sensor networks can be categorized into static and dynamic ones. The static clustering methods aim at minimizing the total energy spent during the formation of the clusters for a set of given network parameters, such as the number of nodes in the network. A problem that is closely related to the static clustering is the localized topology control, which maintains energy-efficient network connectivity by controlling the transmission power at each node, or selecting a small subset of the local links of a node. One way is to minimize the total power levels in all nodes and search for a connected topology.

Another way is to select a minimum set of sensors that form a connected communication graph to cover the entire network region, by iteratively searching for one path at a time and adding the nodes of the path to a set of already selected sensors. The dynamic clustering methods deal with the same energy efficiency problem as the static ones but target for a set of changing network parameters, such as the number of active nodes or the available energy levels in a network. In LEACH (low-energy adaptive clustering hierarchy), the position of a CH was rotated among the nodes within a cluster depending on their remaining energy levels.

It was assumed that the number of active nodes in the network and the optimal number of clusters to be formed were parameters that could be programmed into the nodes *a priori*. A genetic algorithm was proposed to form clusters in terms of a few fitness parameters such as the sum of all the distances from each sensor to the BS. In HEED (hybrid energy efficient distributed) clustering, a CH was selected based on the ratio of the node's residual energy to a reference maximum energy. But the optimal selection of CHs was not guaranteed in terms of energy consumption without knowing the number of active nodes in a network.

IV. EEDC TECHNIQUE

A problem that is closely related to the static clustering is the localized topology control, which maintains energy-efficient network connectivity by controlling the transmission power at each node, or selecting a small subset of the local links of a node. The dynamic clustering methods deal with the same energy efficiency problem as the static ones but target for a set of changing network parameters, such as the number of active nodes or the available energy levels in a network. Energy Efficient Dynamic Clustering (EEDC) technique is developed to minimize the energy consumption.

All the sensors in the network area are clustered into different clusters. In the phase of cluster formation, each node tries to become a CH with a certain probability by wining a competition with its neighbors. In the phase of data collection, each cluster member (CM) communicates to its CH directly by using a MAC layer protocol, such as the *p* persistent CSMA in the IEEE 802.11 standard. In the phase of data delivery, the CH in the hot-spot area aggregates the data received from its CMs and then delivers the aggregated data hop-by-hop to the BS by using a multi hop routing protocol.

V. OUR WORK

Routing has two main functions: route discovery and packet forwarding. The former is concerned with discovering routes between nodes, whereas the latter is about sending data packets through the previously discovered routes. There are different types of ad hoc routing protocols. One can distinguish proactive and reactive protocols. Protocols of the latter category are also called on-demand protocols. Another type of classification distinguishes routing table based protocols (e.g., EEPA) and source routing protocols (e.g., DSR).

- EEDC (Energy Efficient Dynamic Clustering)
  - Formation of a single Cluster
  - Formation of a clustered Network
- EEPA (Energy Efficient and Power Aware)

A.Formation of a single cluster

The nodes having the same radio ranges are clustered together.The battery power of each node is considered in cluster formation. The node which has at least minimum battery power will be allowed to take part in cluster formation. Within a cluster a cluster head will be selected dynamically again it is based on its battery power. The node with high battery power will be selected as a cluster head.

B.Formation of a Clustered Network

The area of the network we have selected is 800*800 m. All the cluster members will communicate to its cluster head. The cluster head aggregates the data collected from its cluster member and it will send the aggregated data to the base station.

C. *EEPA (Energy Efficient and Power Aware)*

This algorithm is based on link state routing algorithm. The main tasks of the algorithm are

1) Neighbor Discovery: responsible for establishing and maintaining neighbor relationships.
2) Information Dissemination: responsible for disseminating Link State Packets (LSP), which contain neighbor link information, to other nodes in the network.
3) Route Computation: Responsible for computing routes to each destination using the information of the LSPs.

D Neighbour Discovery

In the wireless network, HELLO packets are periodically broadcasted and nodes within the transmission range of the sending node will hear these special packets and record them as neighbors. Each node associates a TIMEOUT value in the node's database for each neighbor. When it does not hear a HELLO packet from a particular neighbor within the TIMEOUT period, it will remove that neighbor from the neighbor list. TIMEOUT values are reset when a HELLO message is heard. . The dynamic clustering methods deal with the same energy efficiency problem as the static ones but target for a set of changing network parameters, such as the number of active nodes or the available energy levels in a network. Energy Efficient Dynamic Clustering (EEDC) technique is developed to minimize the energy consumption. The node which has at least minimum battery power will be allowed to take part in cluster formation. Within a cluster a cluster head will be selected dynamically again it is based on its battery power.

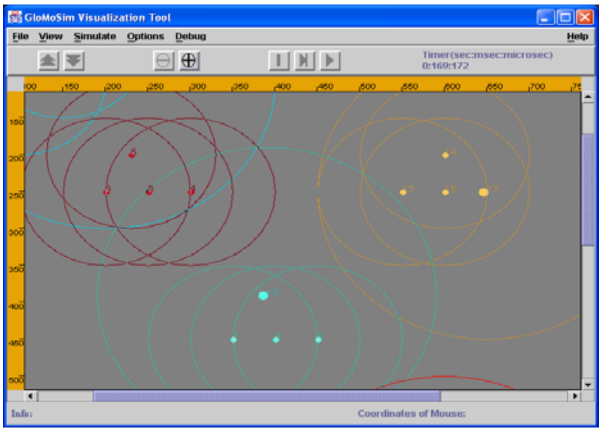

Fig. 1 Example of a Neighbour Discovery

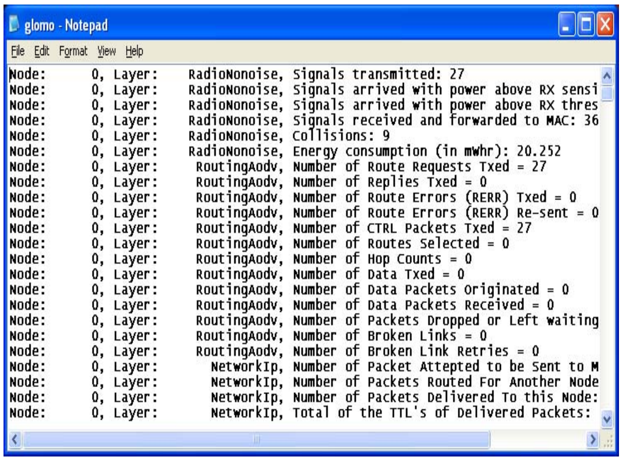

Fig. 2 Example of an Update Interval

E. LSP Integrity

After the node generates a new LSP, the new LSP must be transmitted to all the other nodes. A simple scheme is flooding, in which each packet received is transmitted to each neighbor except the one from which the packet was received. . A genetic algorithm was proposed to form clusters in terms of a few fitness parameters such as the sum of all the distances from each sensor to the BS. In HEED (hybrid energy efficient distributed) clustering, a CH was selected based on the ratio of the node's residual energy to a reference maximum energy.

F. Update Interval

The key difference between EEPA and traditional Link-state is the interval in which the routing information is disseminated. In Link State, the link state packets are generated and flooded into the network whenever a node detects topology changes. EEPA uses a new approach to reduce the number of LSP messages. The original idea of EEPA is to maintain high resolution information within a range of a certain point of interest and lower resolution further away from the point of interest. For routing, this EEPA approach can be interpreted as maintaining highly accurate network information about the immediate neighborhood of a node and becomes progressively less detailed as it moves away from the node. The reduction of routing messages is achieved by updating the network information for nearby nodes at a higher frequency and remote nodes at a Lower frequency. As a result, considerable amount of LSPs are suppressed. When a node receives a LSP, it calculates a time to wait before sending out the LSP from the following equation

UpdateInterval=ConstantTime*hopcount^alpha

ConstantTime is the user defined default refresh period to send out LSPs, *hopcount* is the number of hops the LSP has traversed, Values for alpha are zero and greater than or equal to one. In between the waiting time if the newer LSP is received, the older LSP is discarded. The considerable amount of energy to transmit the older LSP is conserved.

G. Route Computation

Once the node has a database of LSPs, it computes the routes based on the Dijikstra's algorithm which computes all shortest paths from a single vertex. The original idea of EEPA is to maintain high resolution information within a range of a certain point of interest and lower resolution further away from the point of interest. For routing, this EEPA approach can be interpreted as maintaining highly accurate network information about the immediate neighborhood of a node and becomes progressively less detailed as it moves away from the node. The reduction of routing messages is achieved by updating the network information for nearby nodes at a higher frequency and remote nodes at a Lower frequency.

VI. CONCLUSION

Simulation results have demonstrated that the proposed clustering technique and routing algorithms adapt to changes in node power levels, scale well to large-scale networks, and are energy-efficient. The amount of energy spent in both intra and inter cluster communication is minimised. The amount of energy consumed using EEPA algorithm is less when compared to other algorithms. It takes only one mobile node is taken and the mobility of the nodes within a cluster and between the clusters is not considered that could be done as a future work.

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