GENERAL APPROACH FOR THE CONSERVATION ENERGY IN WIRELESS SENSOR NETWORKS

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Abstract :
The wireless sensor networks (WSN) typically consist of a large number of intelligent sensor nodes randomly deployed in an area of interest to supervise or monitor various phenomena (temperature, pressure, humidity ..). During these last years the research in wireless sensor networks has become a very rich field because of the challenges presented in their applications such as limited energy source, limited memory, limited processing capacity, low transmission rate , low bandwidth and high latency caused by the nature of the shared radio channel. Among the most common methods used to ensure effective communication between the nodes of the sensor network is to organize the network into several groups, called clusters; these clusters are disjoint and non-overlapping, each cluster must designate a node cluster chief also called Cluster Head (CH) responsible for managing all the computational operations, routing and data aggregation.

This paper reports an approach to grouping (clustering) the WSN in order to balance the load of broadcast of traffic within the network and thus conserve energy and extend the lifetime of the entire network.

Keywords: wireless sensor networks, lifetime, clustering , energy conservation

1 - Introduction and Motivation:

A wireless sensor networks is composed of a large number of nodes communicating with each other through radio links independently and randomly distributed over an area of interest **(see figure 1)** The detection of a relevant event is sent to the base station directly or by means of communication between the sensors (multi-hop routing). The collected data are processed and analyzed by powerful machines.

The wireless sensor networks are influenced by several factors; however, the real critical challenge in WSN is energy because the sensor nodes are often powered by non-rechargeable batteries. This motivates researchers to look for a method that achieves a compromise between minimizing energy consumption to increase the lifetime of a WSN while maintaining all other performance criteria such as quality of service (QoS)

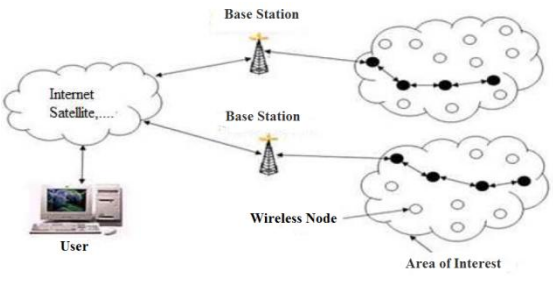


Figure 1: Example of wireless sensor

Generally a wireless sensor node is composed of four basic units [1] **(see figure 2)**:

- Acquisition Unit: converts a physical signal into an electrical one.
- Processing Unit: responsible for all arithmetic operations and storage.
- Communication Unit: consists of a transmitter / receiver for communication between network nodes using a radio channel .
- Power supply unit (battery): it powers the units that we have mentioned and it is generally not rechargeable or replaceable.

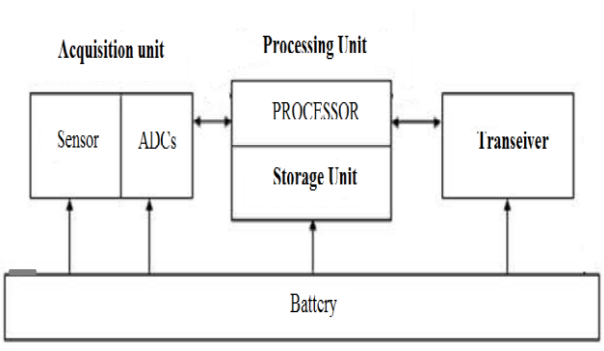


Figure 2: The components of a sensor node

Based on the architecture above the energy consumed by a sensor node is mainly due to the following tasks: sensing, processing and communication.

1.1- Detection Energy:
It is represented in the following operations : sampling, analog-digital conversion, the signal processing , amplification and activating the capture probe .

1.2- Processing Energy :
The processing energy is defined by two types of energy :the switching energy and energy of flight. The energy switching is determined by the supply voltage and the total capacity switched in software (by executing a software). While the energy of flight is the energy consumed when the Processing Unit performs no processing. In general, the processing energy is low compared to that required for communication.

1.3 Communication Energy :
The communication energy is divided into three parts: the reception energy, the energy of transmission and energy in the standby state .This energy is determined by the amount of data communication, the transmission distance and by the physical properties of the radio module. The transmission of a signal is characterized by its power, when the transmit power is high, the signal will have a great range and the energy consumption will be higher.
Note that the communication energy represents the greatest portion of the energy consumed by a sensor node. So any energy optimization of sensor must reach this part of its architecture.

2- Techniques for minimizing the energy consumption :

in wireless sensor networks, the energy consumption is very important because in general the sensors are deployed in inaccessible areas. Thus, it is difficult or even impossible to replace the batteries after their depletion. Thus, the energy consumption of sensors has a great influence on the lifetime of the network . The diagram illustrated in **Figure 3** gives an overview of the techniques used to minimize the energy consumption of a sensor node,which is at the link layer or at the network layer:

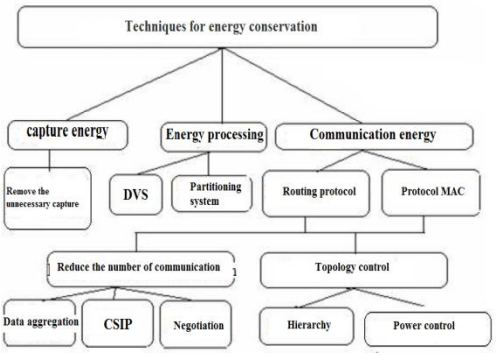


Figure 3 Techniques for energy conservation

As soon as the majority of battery power is consumed in the communication unit , we must find solutions which rely on routing protocols and MAC protocols. Among these solutions there are hierarchy (clustering) and data aggregation.

3- Proposed clustering approach:

The clustering method is achieved in three steps:

a) Initially the nodes of wireless sensors networks are deployed randomly in large numbers in an area of interest **(see figure 4).**
b) the network is virtually divided into disjoint clusters **(see figure 5)**.
c) each cluster select its Cluster Head for the exchange of information within the topology **(see Figure 6).**

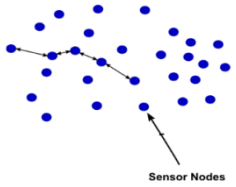


Figure 4 : deployment of nodes

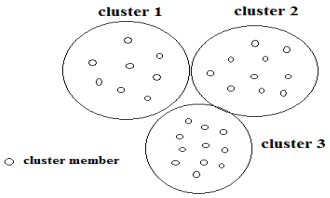


Figure 5 : clustering the Network

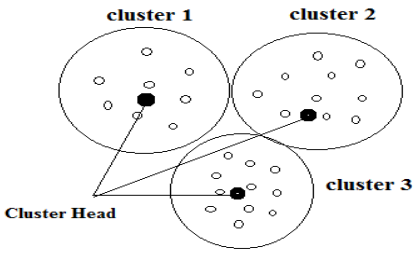


Figure 6 : formation of cluster head

3.1 Clustering algorithm :

For the implementation of the steps mentioned above we need the following parameters:

- **N** : total number of nodes.
- **Nc** : the number of cluster.
- **R** : the radius of cluster, the maximum distance in number of hops to cross a cluster from end to end.

At the beginning all the nodes in the network are normal, after Nc nodes are randomly chosen with certain precautions so that they are sufficiently distributed throughout the network in order to not leave isolated nodes at the end of clustering.
These Nc nodes also called nodes inviting, send an invitation package only once to their direct neighbors, each normal node receives a package, join, his inviting area and rebroadcasts the packet to its neighbors directly.

This process continues until the network is completely partitioned . If a node has received several invitations, it accepts the first and rejects the others. At the end of this stage we obtain Nc disjoint cluster.

NB:

* Inviting nodes lose their property as soon as the network is partitioned.

*Nodes with greater energy in each cluster is selected as a CH.

*A cluster members having direct communication with their neighbors member clusters are selected as gateway nodes to facilitate inter-cluster communication (see Figure 7).

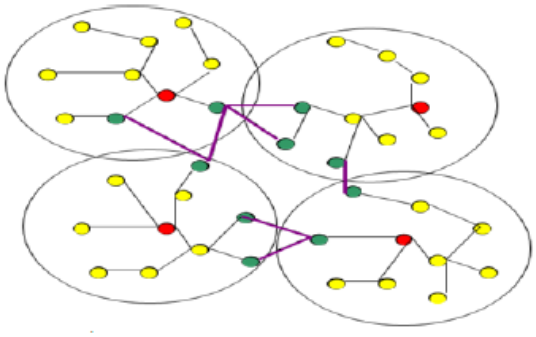
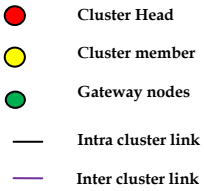


Figure 7 : clustering nodes



Recall that the main objective of our approach is to minimize the communication energy, is possible if and only if the packets exchanged in the network is minimum, which leads us to design a routing protocol data that is less expensive in energy costs.

3.2 Routing protocol:

The data routing is divided into two parts: intra cluster routing and inter cluster routing.

Intra cluster routing: is ensured by members of the cluster itself such as the data exchange between nodes using multi hop routing to the CH which acts as a filter aggregates data collected from its members and eliminates redundant packets (event detected by several sensors).

In intra cluster routing we use DSDV protocol (Destination Sequenced Distance Vector) [3]

the DSDV protocol suitable for the networks of small size (cluster) is based as follows : each node maintains a routing table containing all the possible destinations in his cluster and therefore the routes are calculated in advance so that we can save time to search for a route.

Inter cluster routing : is ensured by gateway nodes, these nodes have in addition to routing table intra cluster a routing table inter cluster to achieve a given cluster.

Aggregated packets are sent to the CH by gateway nodes through multi-hop routing, then they are sent to the next cluster until the destination is found. In the inter cluster routing we use a DSDV protocol's because in general the Gateway number is small.

To achieve the energy balance in the entire network without draining the node battery , we have to alternate the CH role between the cluster members : we classify the members according to their remaining power level as soon as the remaining energy of CH is reduced below a threshold fixed previously the role of CH is assigned to the next node.

4- Ongoing works:

We try to implement a routing protocol with simulator NS2 (Network simulator 2) that reflects this approach with other improvements such as the use of TDMA and FDMA mode.

5-Conclusion:

This paper reported a theoretical approach to energy conservation in WSN and subsequently increased its lifetime. In fact the clustering approach allows to reduce the number of packets exchanged in the network relative to other approaches flat routing protocols (non-hierarchical) like FSR ,DSR ,OLSR[4]… . The use of CH eliminates redundancy that does not exist in the protocol ZHRP [5] , he use of Gateway and alternating the CH role can achieve an energy balance in a WSN in comparison with other protocol that fix the CH role and inter cluster transmission to the same node .

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