

Duty Cylcing Stratagemns for Network Permanency in Wireless Sensor Network

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Abstract

Wireless Sensor Networks (WSNs) having Sensor Nodes (SNs) deployed in the field, is penetrating in all fields of life. Commonly used and appreciated by the research community and general user especially. The energy delinquent in WSNs are the main barricades averting whole manipulation expertise. However, their energy embarrassed nature requires the use of energy effective stratagemns to maximize network lifetime. Emerging such a Medium Access Control (MAC) code of behavior is burning topic zone in this field. For evade deteriorating imperfect power, redeemable functions proposed in MAC code of behavior. Features are to save energy and thus extend the lifespan of the network. We exploit especially the duty cycle and present this as an energy minimizing tool in MAC protocols.

Keywords: wireless sensor networks, medium access control (MAC), energy efficient mechanisms, sensor nodes, protocol

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1. Introduction

In WSNs new architectural techniques are inspiring some previous architectural techniques. We tried hard to cover the all hardware efforts and factors which can effect significantly on the energy efficiency of the WSN.

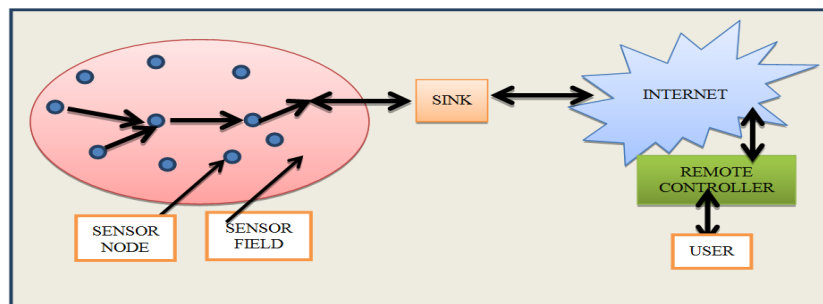


Figure 1. Showing Typical WSN

Sensor Nodes are the devices used for sending and accumulating data in certain area for certain parameters in WSN. SNs sense the data from the respective field and send the data to a sink for further processing. WSN is expanding rapidly because the cost and size of the SNs decreasing day by day. A comprehensive survey on MAC mechanisms showing the unavailability of techniques for making network efficient. Therefore exclusive survey is needed of the time to have the good information about this. SNs field could be of different kind, in which SNs could sense the various kind of physical properties. SNs have very small amount of energy capacity and cannot run long because of this. We cannot replace and recharge the batteries of the SNs in the field, because of the field constraints. Energy must be used judiciously utilized.

2. Energy Saving Mechanisms in WSN

We can broadly classify this like, (A) Internal Energy Saving Mechanisms, (B) External Energy Saving Mechanisms. Now we are discussing all factors in detail as.

3. Internal Energy Saving Mechanisms

Following are the different types of schemes we have, which play a vital role in internally saving of energy. Now we are going to discuss in detail.

3.1. Energy Efficient Scheduling

Centralized and distributed schemes developed for taking sensor fusion into account [1]. Lengthening in broadcasting time to nodes, facing inferior channel conditions, resulting in near to 85% power saving is the requirement of TDMA schemes. Scheduled mechanisms can be classified into two kinds: hierarchical and nonhierarchical network in distributed scheduled mechanisms.

3.2. Scheduled Rendezvous

Transmission of message to all near by sensors is also essential in this protocol. MAC protocol is proposed for environmental monitoring and this technique is vital to reduce the sender and receiver time in wireless medium. It is also for detecting a rendezvous time for switching information. In this process duty cycle schedule put on halt [2]. Strict synchronization & clock drifting are the main disadvantages of this scheme.

3.3. On-Demand Wake-Up Scheme

The significant advantage of this scheme is to help the sensor to have the more duration of sleep time. Two channels are used, which are primary & wake up channel. Sending of information and controlling of packets is associated with Primary channel. And channel is used for wakeup signal for neighbors [3]. The disadvantage of this type of scheme is that, the alarm pushes all near by for wake up, and thus it is wastage of energy.

3.4. Directional Antennae

Localization and positioning are major issues while using directional antenna in MAC design. Using of directional antennae and reducing duty cycle can result in increasing of Network lifetime. Directional antenna focuses on target, reducing wastage of power. Signal interference, deafness and the adjustment are the often issues associated with the directional antennae [4].

3.5. Clustering

Grouping of sensors in a certain pattern to achieve certain goals is called clustering in network. Clustering provides scalability, robustness, decreased energy dissipation & minimize the number of nodes. We can classify clustering in many ways, but Weighted, Hierarchical, Heuristic, Grid are very popular [5]. Various other schemes implemented to achieve the predescribed goals and to increase the performance of the network.

3.6. Duty Cycling

In this context duty cycling is referred to the node active and sleep mode of operation. Switching of node between the active and nonactive modes. It is distributed scheme. Networking subsystems are mainly dependent on duty cycling. It is the extremely used technique in MAC protocols for reducing energy consumption and increasing efficiency in WSN. Sleep and wakeup technique is extremely used for reducing the energy burden. In MAC protocols we also do this for getting such results. We observed that sleep mode is efficient than idle mode interms of energy consumption. Timing and duration of sleep and idle mode issues usually occurred in duty cycling mechanisms are discussed and the work towards the solution is presented. It is presumed in the research society that S-MAC is the first to give the idea of the method of taking decision on the basis of knowledge of traffic pattern is called adaptive duty cycle.

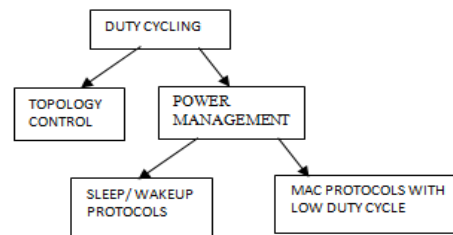


Figure 2. Classification of Duty Cycling

It is supposed that adaptive cycling is firstly introduced and sleep/wakeup mechanism to conserve energy [6]. On comparison of duty cycling, we find T-MAC has good features over S-MAC. Listening period ends when any event is resumed for a given time threshold in the T-MAC. T-MAC has the disadvantage of early sleeping problem due to that even neighbour's messages may be missed. Based on CSMA another solution reducing idle listening and minimizing power wastages is the Synchronized preamble sampling [7]. For a short duration of time, every node regularly samples and listens the radio channel. It can find the length of data based on awareness of the sleep mode in the near by sensors. WiseMAC sleep and wake-up mode duration of nodes could be found adaptively and thus saving energy of nodes. For sending packets increase the complication and wastage of power. While we have no such problem in asynchronous MAC protocols like X-MAC and WiseMAC. By adjusting the length of active period, duty cycle could be improved and fairly utilized and minimized the daily thus improving the efficiency of the network [8]. Mechanism is adopted for dynamically change of the duty cycle. This decreases the delay in transmission of S-MAC by introducing this technique. Clock drifting is another problem in duty cycling and becomes significant in the scenario of very low duty cycle and traffic load thus decrease the performance of the network [9].

3.7. Adaptive Sensing

This technique is able enough to vary the node activity to the actual dynamics of procedure. Number of samples can be minimized to a certain level by using this sensing technique. Therefore process and transmission burden becomes less. In future node specific method will be adopted by the operating system to give the relief to the manual management. This will also improve the duty cycle mechanisms. Adaptive sensing & duty cycle are essential methods. Some time these two approaches can be used as a combination. Adaptive sensing has three approaches, following are those [10].

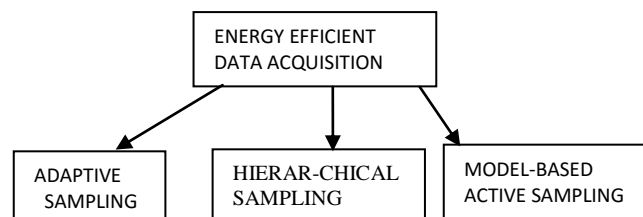


Figure 3. Categorization of Energy Efficient information Acquisition

3.7.1. Hierarchical Sensing

If we need more precise sensing information than we will use contemporary complex sensors for this job. But for this process more energy will be consumed. Advanced sensors are more useful in terms of sensing, resolution and efficiency but we have to bear the cost and energy. This technique is very much useful and effective. In this technique we have multiple sensors and we can dynamically select any of them for improving accuracy.

Triggered Sensing: Triggered sensing example is shown in [11], it is used for finding the health of structure and the damage done during the catastrophe in the bridge specially.

Accelerometers are put on ON state for collection of data and subsequently assessment of incoming data for potential damage. The nodes remain in ON state if they detect something unusual. The other nodes remain in OFF state just for the sake of energy. Strain gauges are deployed for the further good result. Central sensor broadcasts the data to BS, having the information regarding damage location. After this sensor returns to sleep mode for saving energy.

Multi-scale Sensing: This can be achieved by concentrating on low resolution information. In this technique high resolution sensors are added in the system in the already found area only. In the case of fire energy management, effective implementation of this technique may get reliable results [12]. Static sensors are used in the field for getting monitored sensed data.

3.7.2. Adaptive Sampling

Adaptive sampling technique makes the relations between two informations, detecting information and remaining energy. These two approaches can be combined for reducing the samples amount by activity-driven adaptive sampling. By using harvest aware adaptive sampling, sampling rate can be controlled. Data losses problem comes in this technique usually. While it is not good condition as such of have data loss. Because we need 100% data availability. We can achieve this by using by taking measure of reducing the problem. Those measures are re-broadcasting, error correction techniques. Multi path is also good in this regard.

Activity-based Adaptive Sampling: Time based relationship is used with adaptive sampling technique [13]. This technique reduces the time taken activities of node and radio and thus saves the energy. This also ensures the accuracy in the acquired information. Avalanche anticipation and snow deposition on the peaks of mountain is the good example to work with this technique. This technique can estimate the optimal sampling frequency of the sensed signal.

Harvesting-Aware Adaptive Sampling: We can have optimized energy consumption at unit level by taking into account both types of the data, the information coming from the model and the data based on remaining battery energy level. Solar radiation as an energy harvesting source and define a time-varying energy harvesting prediction model [14]. Harvesting transducers enforce a threshold on immediate energy available, in lieu of on the whole power. Prime importance is to adjust the work burden distribution to the spatio-temporal power availability outline in order to allow power-unbiased of the network.

3.7.3. Model-Based Active Sensing

On sensed phenomenon of initial set of sample information, we can build a model based on forecasting. This model can predict and that data might be verified by the passage of time. This is very much helpful for putting cut on power consumption for information sensing and broadcasting. By the time, this may be observed that the given information by this model is not being verified. In this type of condition, we have to upgrade this model in accordance with prevailing parameters.

4. External Energy Saving Mechanisms

Besides the mechanisms discussed, there are some other methods those are known as external mechanisms, supports for energy efficiency in WSNs. Below are the detail,

4.1. Energy-Efficient Routing

Hierarchical routing scheme is based on 3-tiers. Sensor can be grouped by using TDMA based MAC protocol before the operation of network [15]. Network lifetime can be maximized by, if we define link cost a function of sensor's present power and the power which is required. Data routes are presented for maximizing the lifetime.

4.2. Energy Efficiency through Topology Control

Besides of others Topology control, the technique for energy saving for WSN network. We consider so much about topology in WSN. Because out of this, energy saving concept is incomplete, it is the way we can do this easily. This is the management mechanism for reducing the consumption. In this scheme we select some sensors for building up the forward backbone

while others sensors keeps in sleep mode for the saving energy [16]. First we have to control power and sleep scheduling, second manage the traffic load and routing in the last.

4.3. Data Aggregation and in Network Processing

Data aggregation if associated with network maximize the efficiency, performance and minimize the energy consumption and time. Sensor node generate thousand of data. If this redundant information is accumulated and broadcast once, can save the many transmission rounds and thus saving energy, cost. Rigorous nonlinear mathematical formulation is presented for resolving the problems, which is centric to the routing schemes used [17].

Table1. Comparison of Duty Cycle Protocols

MAC Protocol	Synchronization Required	Adaptability	Energy Efficiency
B-MAC	Not Required	Adaptable	Efficient
X-MAC	Not Required	Adaptable	Efficient
T-MAC	Not Required	Adaptable	Efficient
SMAC	Not Required	Adaptable	Efficient
SCP-MAC	Not Required	Adaptable	Efficient
WiseMAC	Not Required	Adaptable	Efficient

5. Conclusion

We focus on mobility based schemes and data driven schemes. Sparse sensor network architecture have many space for researchers for developing. Mobility of collector nodes is becoming more charming for getting effective network and increasing the performance. For the upcoming researchers integration of various energy saving techniques to make a solution of different problems at the same time will be very lucrative field. Usually energy-efficient data acquisitions technique is based on a duty cycling. Resulting in good detection of target. Environmental sensing could be done failry by using multiscale sensing technique. Event based adaptive sampling getting more space among the research society. Adaptive sampling is the effective technique but having the loss of data problem as disadvantage. Harvesting aware adaptive sampling is the most useful and effective too. It is dependent on predictable source, which is the disadvantage of this scheme. Model based active sensing is growing and famous technique recently. More effective technique can be built based on spatio-temporal correlation.

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