A Review on - Optimal Path Selection In Sleep Awake Cycling In Wireless Sensor Network

Sarvjeet kaur, Er. Jasmeet Singh

***Abstract*— *A wireless sensor network is a distributed network system consisting of distributed nodes called sensors.* Sensor nodes are disposed to to have errors. It is thus needed to sense and locate defective sensor nodes to ensure the quality of service of sensor networks. We propose an asynchronous based wakeup scheduling scheme, which optimizes energy saving ratio and achieves bounded neighbour discovery latency, without requiring time synchronization. Heterogeneous duty-cycling causes transmission latencies to be time-varying. Hence, the routing problem becomes more complex when the time domain must be considered for data delivery in duty-cycled WSNs. We formulate the routing problem as time-dependent Bellman-Ford problem. In this, it presents a multipath routing protocol for data transmission. The main issue is the energy wastage of unused nodes. So, to overcome this, it proposes an on demand asynchronous sleep awake protocol for reducing energy consumption. In this, optimal path selection is based on shortest distance between nodes which is to be calculated. The projected mechanism is implemented with MATLAB.**

***Index Terms*— Duty Cycle, Optimal Path Selection, Wireless Sensor Network, Sleep Cycle etc.**

I. INTRODUCTION

Wireless sensor networks have been tremendous advantage and utilization in past two decades. The past two decades have witnessed the proliferation of Wireless Sensor Networks (WSNs) an enabling technology for various applications that involve long-term and low-cost monitoring, such as battlefield reconnaissance building inspections, security surveillance, and other. In most WSNs, the battery is the sole source of energy for the sensor node. Sensor node is expected to work on batteries for several months to few years without being replenished [4].

Sensor nodes are the elementary components of any WSN and provide the following basic functionalities[6] 1) signal conditioning and data acquisition for different sensors;2)temporary storage of the acquired data; 3)data processing; 4)analysis of the processed data for diagnosis and, potentially, alert generation; 5)self- monitoring (e.g., supply voltage); 6)scheduling and execution of the management task; 7)management of the sensor node configuration; 8)reception transmission of forwarding data packets; 9)coordination and management of communication and networking.

The use of wireless sensor networks is increasing day by day and at the same time it faces the problem of energy constraints in terms of limited battery lifetime. As each node depends on energy for its activities, this has become a major issue in wireless sensor networks. The failure of one node can interrupt the entire system or application. Every sensing node can be in active (for receiving and transmission activities), idle and sleep modes. In active mode nodes consume energy when receiving or transmitting data. In idle mode, the nodes consume almost the same amount of energy as in active mode, while in sleep mode, the nodes shutdown the radio to save the energy

In WSNs the only source of life for the nodes is the battery. Communicating with other nodes or sensing activities consumes a lot of energy in processing the data and transmitting the collected data to the sink. In many cases (e.g. surveillance applications), it is undesirable to replace the batteries that are depleted or drained of energy. Many researchers are therefore trying to find power-aware protocols for wireless sensor networks in order to overcome such energy efficiency problems.

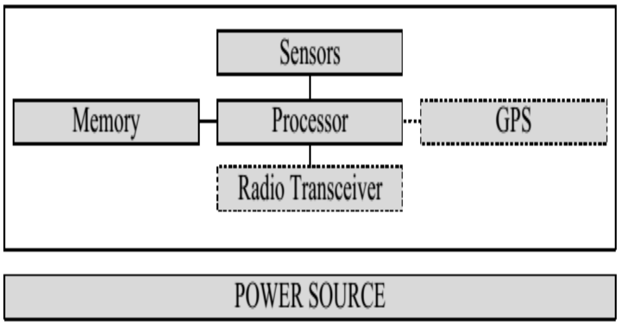

Figure 1: Wireless Sensor Network Schematic [1]

One reason behind the growing popularity of wireless sensors is that they can work in remote areas without manual intervention. All user needs to do is to fold the data sent by sensors, and with certain examination extract meaningful information from them. Usually sensor applications involve many sensors organized together. These sensors form a network and collaborate with each other to gather data and send it to the base station. The base station acts as the control centre where the data from the sensors are gathered for further analysis and treating. In a husk, a wireless sensor network is a system consisting of spatially dispersed nodes which use sensors to monitor physical or environmental circumstances. These nodes combine with routers and gateways to generate a WSN system [4].

The development of sensor networks requires technologies from three different research zones: sensing, communication, and computing (as well as hardware, software, and procedures). Thus, combined and separate progressions in each of these areas have driven investigation in sensor networks. Examples of early sensor networks comprise the radar networks used in air traffic regulator. The national power grid, with its numerous sensors, can be viewed as one large sensor system. These systems were recognized with

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specialized computers and communication capabilities, and before the term “sensor networks” came into vogue [5].

The paper is ordered as follows. In section II, we discuss correlated work with wireless sensor networks. In Section III, It defines Sleep scheduling techniques. In Section IV, it describes proposed work of system. Finally, conclusion is explained in Section V.

II. LITERATURE REVIEW

Some proposed that multipath routing protocols improve the load balancing and quality of service in WSN and also provided reliable communication. This paper investigated various multi-path routing protocols of the WSN in the literature and illustrates its assistances. The main elements of these systems and their classifications based on their attributes had been also discussed. A comparison of these protocols which were of great help to understand the properties and limitations of existing solutions had been done in the following study [7].

Some proposed that Wireless Sensor Networks (WSN) is an interconnection of a large number of nodes deployed for monitoring the system by means of measurement of its parameters. Recent investigation in wireless sensor networks had led to various new protocols which are particularly designed for sensor networks. To project these networks, the factors desired to be considered are the handling area, mobility, power consumption, communication capabilities etc. In this, a survey was given regarding the architecture design issues, classification of protocols. The paper explored with research issues for the realization of networks [9].

Some author proposed a fault node recovery algorithm to enhance the lifetime of a wireless sensor network when some of sensor node shut down, The proposed algorithm increased the number of active node up to 8.7 times, reduce the rate of data loss by approximately 98.8%, and reduce the rate of energy consumption by approximately 31.1%[1]

Some reviewed current asynchronous WSN MAC protocols from the delay efficiency perspective, and to investigate on their latency. The asynchronous protocol are divided into six categories: static wake-up preamble, collaborative schedule setting, collisions resolution, receiver-initiated, and anticipation-based [3] review indicated that some of these protocol can ensure end to end delay decrease, but none of them can provide delay guarantee for time-constrained applications. Consequently, a huge effort is needed in order to enable successful deployment of WSNs for delay-sensitive application using asynchronous MAC.

Authors proposed an adaptive and cross-layer framework for reliable and energy efficient data collection in WSNs on the IEEE 802.15.4/ZigBee standards. Specifically, proposed a low complexity distributed algorithm, called Adaptive Access Parameters Tuning (ADAPT), that can effectively meet the application-specific reliability under wide range of operating conditions, for both single-hop and multi-hop networking scenarios[9]The proposed framework supports multi-hop wireless sensor network based on the ZigBee specifications, and is flexible enough to implement diverse adaptation policies.

Author proposed a new sleep scheduling algorithm, named EC-CKN (Energy Consumed uniformly-connected K-Neighborhood) algorithm, to prolong the network lifetime. The algorithm EC-CKN, which takes the nodes residual energy information as the parameter to decide whether a node to be active or sleep, not only can achieve the k connected neighbor nodes have more residual energy than other neighbor nodes at the current epoch.[8] In this research work Author made the following major contributions for supporting the realistic WSNs applications: 1)A new sleep scheduling algorithm named EC-KCN, is proposed to balance the energy consumption and prolongs the network lifetime. 2) Solid simulation work is conducted, which proved the energy consumption in EC-CKN based WSN is well balanced.

Author presented geographic multicast routing(GMR), a new multicast routing protocol for wireless sensor networks. It is a fully localized algorithm that efficiently delivers multicast. Data messages to multiple destinations. Simulation results show the GMR outperforms position based multicast in term of cost of the trees and Computation time over a variety of networking scenarios [12].

III. SLEEP SCHEDULING IN WSN

Generally, operation of wireless sensor network involves communication between sensor node and base station. In WSNs the only source of life for the node is battery. Communicating with other nodes or sensing activities consume a lot of energy in processing the data and transmitting the collected data to the sink. In many cases (e.g. in surveillance applications), it is undesirable to replace the batteries that are depleted or drained of energy. Many researcher are therefore trying to find power aware protocol for WSNs in order to overcome such energy efficiency problem. All the protocols that are designed and implemented in WSNs should provide some real-time support as they are applied in areas where data is sensed, processed and transmitted based on an event that’s lead to an immediate action. A protocol is said to be real-time support if and only if it is fast and reliable in its reactions to the changes prevailing in the network. It provide redundant data to the base station and or sink using the data that is collocated among all the sensing nodes in the network.

The network lifetime is usually defined as the time until the first node fails because of energy depletion. So sleep awake scheduling is effective mechanism to increase network lifetime. We propose asynchronized sleep-awake scheduling protocols to increase the network lifetime. In these protocols, sensor nodes periodically or aperiodically exchange synchronization information with neighbouring nodes. However, such synchronization procedure could incur additional communication overhead and consume a considerable energy. On demand sleep-awake scheduling protocol is one scheduling protocol where nodes turn off most off the circuitry and always turn on a secondary low powered receiver to listen to “wake-up” calls from neighbouring nodes when to relay the packet. In this we have proposed a asynchronous sleep-awake scheduling in which each node wakes independently of neighbouring node for energy saving. However, this independence of the wake-up process additional delays at each node along the path to the sink because each node needs to wait for its next hop node to wake up before it can transmission of the packet. This delay could be unacceptable for delay sensitive applications which require the event reporting delay to be very small. So for minimizing this event reporting delay, use of multiple radios is required.

A. Power Management Protocol

The power management protocol for WSNs is one of the main energy conservation techniques available for a WSN. The power management protocol can be classified into two categories depending on the location of the power saving within the network layering. Each category of these power management protocols is best suited for a certain type of network topology .The two power management protocols are independent sleep-/wakeup protocols running at the network or application layer and integrated with the MAC protocol itself. Based on the specific sleep scheduling, the MAC protocol then optimizes the medium access functions which are used for power management. Independent sleep/wakeup protocols can be used in combination with any MAC protocol in order to reduce the energy consumption. Within these kinds of sleep/wakeup protocols a classification can be made into three main categories: on demand, scheduled rendezvous and asynchronous protocols.

1. The On-demand Protocol

First of the power management protocol that is introduced is the on-demand protocol. This procedure is based on the plan that a sensor node should be in the sleep mode or off when there is no data packet to broadcast and/or receive. As soon as there is a data packet that needs to be transmitted and/or received the sensor node shall become active. In this way sensor nodes alternate between active and sleep periods depending on network activity. The consequence is that the energy consumption is minimized since sensor do not waste energy by unnecessary transmissions and unnecessary sensing. But the main disadvantage of this protocol is that it is difficult to inform the sleeping sensor nodes if another sensor node wants to communicate with them. In order to combat this disadvantage the use of multiple radios is required. This requires two channels to work corporately, namely a data channel and a wakeup channel, the former one is used for normal data communication and the other one is for awaking neighbouring sensor nodes when needed.

2. The Scheduled Rendezvous Protocol

The second power management protocol is called scheduled rendezvous protocol which belongs to the synchronous protocols since it requires all neighbouring sensor nodes to wake up at the same time. In this approach sensor nodes wake up according to a wakeup schedule and remain active for a short time interval to communicate with their neighbours. After the transmission of the data the senor nodes will go to sleep until the next rendezvous time. The main advantage of this protocol is that it is guaranteed that if a sensor node is awake that all its neighbouring sensor nodes are awake as well. It is very convenient for data aggregation and allows sending broadcast messages to all neighbours. The disadvantage is that this protocol is a synchronized protocol which requires all the neighbouring nodes exchange the synchronization information so that their clocks are synchronized.

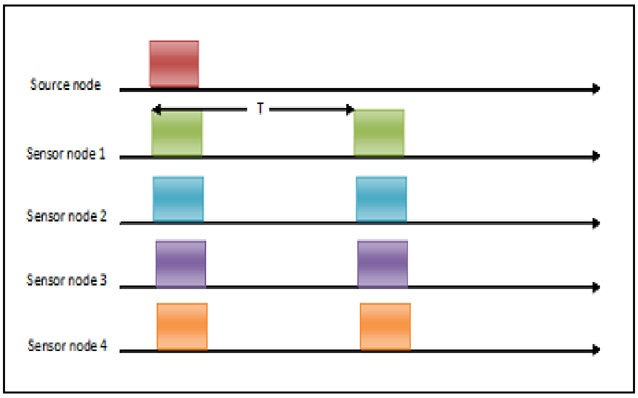

Figure 2: The Sleep Scheduling for a Synchronous Protocol

3. The Asynchronous Protocol

The last algorithm that can be used is the asynchronous protocol. The basic idea is that each node is allowed to wake up independently of the others by guaranteeing that neighbouring sensor nodes always have overlapped active periods of time within a specified number of cycles. According to this only sensor node 1 and sensor node 3 can receive the transmitted packet. Since the active period of the sensor nodes partially overlap with the active period of the source node. One of the advantages of this protocol is that a sensor node can wake up at anytime when it wants to communicate with its neighbouring sensor nodes.

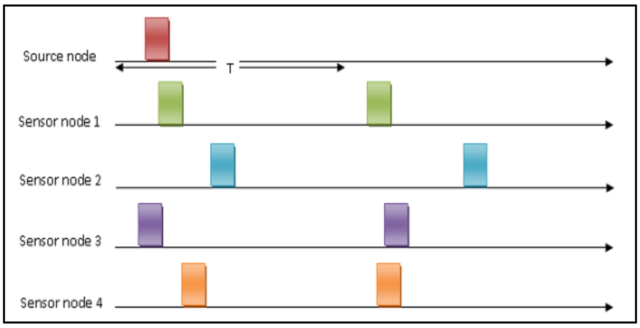

Figure 3: The Sleep Scheduling for a Asynchronous Protocol

IV. METHODOLOGY

In order to reduce the end-to-end latency with an energy efficient data transmission proposed an Asynchronous Wakeup Schedule (AWS) in WSNs. Each node was assigned a particular color. Data transmission is an important topic of WSNs, as the distance between each sensor nodes is different; the energy consumed by each sensor node is different. When the distance between a sensor node and the base station is large the data transmission from sensor node to base stations consumes more energy than in the case when the distance is small. Hence the distance between sensor nodes among another and the distance from sensor nodes to the base station impacts the lifetime of the WSNs. Data transmissions can be classified into two categories, namely direct transmissions and indirect transmissions.

In a direct data transmission, each sensor node collects and transmits the data to the base station directly, there do not exist any intermediate nodes for transmission, the path which from sensor node to the BS can also be called single-hop path. The advantage of direct transmissions is that the data rate is higher and the implementation is easier. Indirect transmission means that sensor nodes send their collected data to intermediate nodes also called relay nodes that are in the proximity of themselves. This relay node will then forward the aggregated data to the BS, the path from the sensor node to the BS is also called multi-hop path. The advantage of this kind of transmission is that the high energy consumption problem in long distance transmission has been solved.

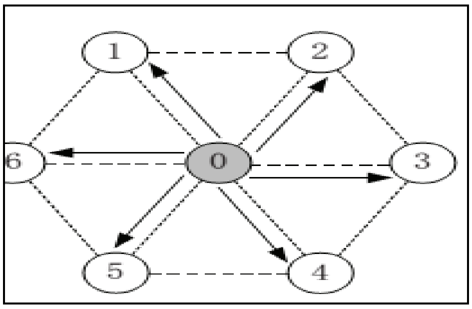

Figure 4: Single Hop Routing [10]

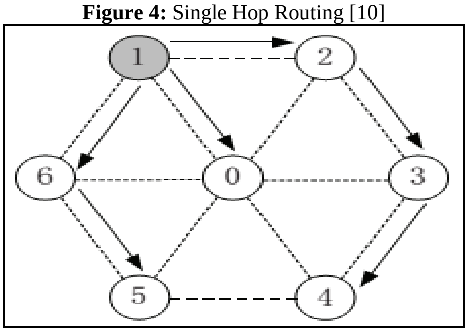

Figure 5: Multi-Hop Routing [10]

Broadcasting works that if a sensor node wants to transmit data it will broadcast the data to all its neighbouring nodes. The sensor nodes that received the packet from the source node shall further rebroadcast the packet to their respective neighbouring sensor nodes which the source node could not reach. In this way in a short time the entire network is reached. Although broadcasting has many advantages such as it is simple to implement, fast and robust, it also has some disadvantages.

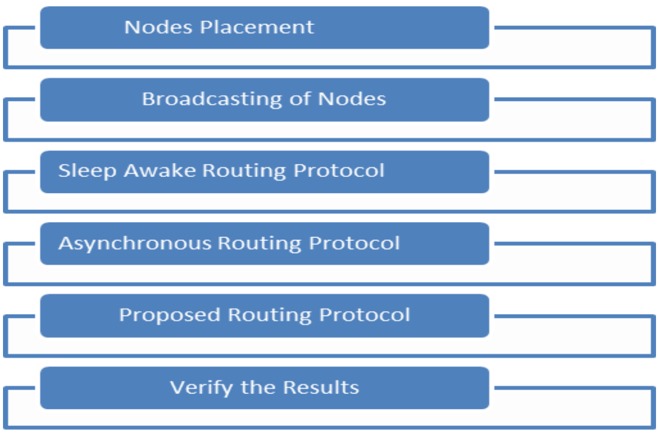

Figure 6: Proposed Steps of a System

V. CONCLUSION

In this work, it reviews the sleep scheduling of nodes in WSN. Different from previous works, we neither assume time synchronization for sleep scheduling, which requires all neighbouring nodes to wake up at the same time, nor assume duty-cycled awareness, which makes it difficult to use in low duty-cycled WSNs. In this, it proposes an on demand sleep awake protocol for energy saving. In this, nodes are in ON state when there is a demand for that node otherwise all nodes are in sleep. This protocol is a part of asynchronous sleep protocols. All these are useful for reducing the energy consumption and improve the accuracy. In this, optimal path selection is based on shortest distance between nodes which is to be calculated.

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