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# Review and Analysis of Power Scheduling and Energy Efficient Algorithms

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**Abstract-** The wireless sensor network finds its use in all aspects of life spanning over medical, military applications and communication to name a few. There is a need to be able to use these networks in an efficient manner. Power scheduling algorithms not only facilitate increased battery life of the sensors and system but also result in efficient power consumption. There have been several algorithms and methods postulated by eminent scientists and researchers all over the world on the practical use of power in the wireless sensor networks. Some of their work have been mentioned in this paper.

**Index Terms-** Wireless Sensor Network, TDMA, Scheduling Protocols

## 1. INTRODUCTION

Wireless sensor network refers to a group of sensors which are spatially distributed in a confined space. These sensors are predominantly used to measure environmental as well as physical conditions such as pressure, temperature, and sound. The information obtained is further passed on to the primary location through various networks. The WSN is also referred to as an actor sensor or WSAN. Every node or device in the wireless sensor network has a limited battery life. This brings about an issue, as the communication and computing capability of every node becomes finite.Due to the use of wireless sensor networks on such a large scale in various fields such as health care management, wireless communication, hardware, and software, efficient power consumption as well as increased energy efficiency per node is the need of the hour. Various algorithms have been put forth by researchers to maximize the utilization of wireless networks along with efficient energy consumption. Following are the primary multiplexing methods which are also described in Fig. 1:

1) Frequency Division Multiple Access (FDMA)

2) Time Division Multiple Access (TDMA)

3) Code Division Multiple Access (CDMA)

4) Orthogonal Frequency Division Multiple Access

5) Spatial Division Multiple Access (SDMA).

After studying different papers on WSN scheduling algorithms, it has been seen that most of the methods implemented in schedule are based on TDMA.Since TDMA has the equal interval of time for transmitting and receiving each node, it removes idle listening and thus has become the modern approach to developing new scheduling methods.

In TDMA scheduling, most of the newly developed algorithms have the emphasis on time low latency scheduling protocols viz. EEWS ,MDS, DAS, TRAMA,DMAC,etc.

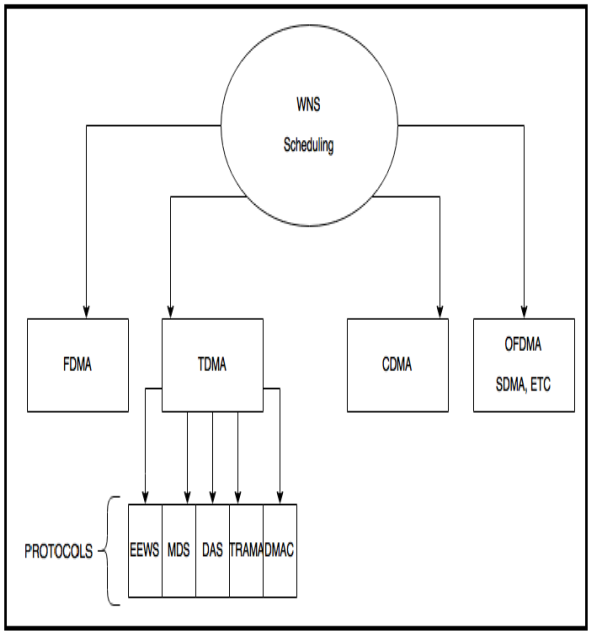


Figure1 WSN Scheduling: TDMA Focus

## 2. RELATED WORK

Hongliang Ren and Max Q.H. Meng, Fellow, IEEE put forth an algorithm for maximizing the power saving capacity for wireless sensor network using particle filter [1].This algorithm explained that the primary cause of energy consumption in wireless sensor network was due to the persistent use of RSSI (RSS indication).This evidence was necessary to

check the location of a particular node in the network. The strategy used to save power was with the use of MAC (medium access control) protocol. This protocol, when used to detect the location of each node, showed a much lesser power consumption per node than before. It made use of a message passing framework, which was integrated along with the MAC protocol so as to carry on the process of particle filtering. Every node obtained the location of its neighboring node using the RSS information respectively. The localization based on particle filtering method took into account the information obtained from the neighboring nodes, without any particular hardware requirements. This algorithm showed good results which helped in achieving an energy efficient network with less power consumption as compared to the algorithms proposed in [2], [3], and [4] respectively.

Octav Chipara, Zhimin He et.al. Proposed an effective method for minimizing power consumption in wireless networks. In this way, a solution to reduce the end to end communication amongst the nodes was put forth. This was achieved by a Real-time Power-Aware Routing (RPAR) pro-tooling this protocol and efficient communication among the nodes of the network was made at a low cost by dynamically altering the transmission power. This was accompanied by taking smart routing decisions at the right time. This algorithm is useful for resource dependent wireless networks as it uses the aware power policy and also an effective node manager, which manages the nodes of the network. This algorithm maximizes the scalability of the network along with minimizing the constraints related to memory and bandwidth of the network. Hence, it is mostly used to cater to the resource dependent network, so as to minimize the energy constraints and hence maximize the reliability of the network as a whole.

Sumit Kumar and Siddhartha Chauhan stated that the limited bandwidth and battery life of the nodes of the wireless network can be overcome by using various scheduling algorithms such as TDMA (time division multiple access) based MAC protocols. The use of TDMA protocols is done after carefully studying the crucial properties of the sensors. This helps in achieving a topological information of every node existing in the network thereby minimizing the battery consumption per node. This further maximizing the use of potential energy of each node thus, reducing the data retransmission due to a collision. It was observed that the node could not transfer the required information over the network when it was out of power. In the process, most of the energy got wasted. There are many reasons as to why the energy of the nodes got lost within a network. Some of the reasons were as follows: wastage due to overhearing[7], due to data aggregation[8] and due to over emitting[7]. TDMA based scheduling algorithms predominantly play a significant role in accelerating the working of the nodes within the network, if time constraints an issue. Wireless sensor networks with time constraint are used in various operations such as in tactical systems and environmental monitoring. Hence, this algorithm is widely used to save energy as well as to increase the bandwidth of the network and battery life of each node.

Raghavendra V. Kulkarni and Ganesh Kumar Vinayak-smoothly formulated the PSO (Particle Swarm Optimization) technique. This method addresses issues like data aggregation, limited computational efficiency, link failures and node localization respectively. It was observed that majority of the problems regarding the energy consumption of the node could be diminished using the PSO technique, which is also multi-dimensional in nature[10].Most of the existing analytical solutions face a lot of problems regarding the convergence of the final solution. This technique produces optimized high-quality solutions in less amount of time. This solution helps in exempting the nodes from unwanted computational burden thereby, achieving a faster convergence of data.This technique has also helped in achieving cross-layer optimization across the nodes. Hence, as per the observed results, it greatly helps in energy conservation along with increased efficiency of the network.

Yuan Tian, Eylem Ekici et.al. put forth a task map-ping and scheduling algorithm, namely, EcoMap(Energy-constraint Task Mapping and Scheduling)[12].This solution so provided exists for one hopped homogeneous WSNs respectively. The experiments were performed on a num-ber of homogeneous clusters of WSNs. The task mapping and scheduling algorithms, when applied to the sensors, showed an increase in the performance and computational capability per sensor. It makes use of a channel modeling, and a sensor failure was handling algorithm This process also used a computation scheduling algorithm.The results so obtained were further evaluated through Directed Acyclic Graphs (DAG).This DAG was randomly obtained as a result of various experimentations performed. It was seen that the outcomes had been far better as compared to the parallel processing solutions used in WSN. Hence, this algorithm showed good results regarding energy constraints as well as computational capability per sensor and thus is widely used.

Christopher J. Rozell and Don H. Johnson proposed a power scheduling algorithm for wireless sensor network. It was estimated that majority of the power

consumption of the sensors in the wireless network was due to the sustenance of coordination between the actuator nodes and the overlapping sensors. This coordination was observed to be difficult to obtain without a centralized controller. The power scheduling algorithm so proposed provides an ideal solution to deal with situations of this kind. In this algorithm, a resource allocation strategy was used. In which weights were associated with every sensor-actuator link. Further, these weights determined the importance of such communication links over the entire network. Further using the MQAM strategy, these communication links are quantized with some bits. The number of these bits is variable in nature. In the end, the links are then optimally allocated, depending on the current activity of the WSN. This strategy has shown better results as compared to the uniform allocation strategy. Also, it has helped in the decentralization process wherein the need for a single head node could be eventually eliminated [15].Hence using this algorithm, energy could be efficiently saved between the respective communicating links in the WSN.

Thai, M.T., Yingshu Li et.al. put forth an efficient method to conserve the overall power consumption of the wireless sensor network by successfully activating the given set covers[16].Each set cover consisted of a particular number of sensors. However, the sensors within an active set cover would perform activities like collecting data and transmission of the received data while all the other nodes present in the network would automatically go into the sleep mode. Also, the sensors performed tasks in multiple sets, thereby increasing the lifetime of the wireless network as a whole. A model solution using this approach was presented. This model made use of the greedy approach using linear programming. It was observed that this method gave better results regarding power consumption of the network thereby increasing the lifetime of the associated sensors.

## 3. CONCLUSION

As Wireless sensor network is significantly used in various areas of applications like health care, military, software, smart spaces, etc.[17][18][19], efficient use of energy and power consumption are the need of the hour. It is of utmost importance that the battery life, as well as the computational capabilities of every sensor in the WSN, should be increased. This paper highlights a few power scheduling and energy efficient algorithms proposed by some eminent researchers. These algorithms have not only contributed greatly to the field of WSN but have also helped achieve the required goal of power and energy saving. In-depth research has been conducted in this area specifically; however the strategies mentioned above have proven to be useful, depending on the requirement of the WSN.

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