

# **A Survey on Techniques of Energy Efficiency in Wireless Sensor Networks**

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**Abstract-** Today Wireless Sensor Networks (WSN) is used in many industries. WSN consist of large number of self organized sensor nodes with sensing, computation and wireless communication capabilities. These sensor node are distributed in monitored area used to collect, transmit and process data. In WSN it is very difficult to charge or replace the batteries, thus energy efficient communication is important part in WSN. Therefore to increase the network lifetime is primary objective in WSN.

**Index Terms-** Energy Efficient Communication, Silent Periods, Wireless Sensor Networks.

## **1. INTRODUCTION**

WSN have been used for many applications such as forest fire detection, industrial monitoring, remote healthcare, environmental monitoring, and agricultures. In medical application, WSN is used to monitor the various parameters of patients such as temperature, blood pressure, heart rate and send this information wirelessly to a control station. WSN consist of small ad-hoc sensor device node working together to complete a common task. These sensor nodes provide the information about status of the specific system [4].

The information could be measurement of environmental or physical parameter such as pressure, temperature, vibrations [8]. The information will then be sending wirelessly and received by central location for further analysis and usage. Each component of sensor node performing different task of work and each of these component required power sources. In WSN it expected that battery powered devices are operated in long periods of time because of difficulties in replacing the batteries.

So, increase the battery lifetime or save the transmission energy is very important in WSN. To reduce the device recharging cycle periods is very important in WSN to provide the connectivity for longer duration of time [5].

## **2. RELATED WORKS**

Number of communication scheme such as Energy based Transmission (EbT), Communication through Silence (CtS), Variable based Tacit Communication (VarBaTac), Ternary with Silent Symbol (TSS), and RBNSizeComm are used to provide energy efficient communication. Data aggregation algorithms are also used to save the transmission energy for these clustering methods are used in wireless sensor network.

### **2.1. Energy based Transmission**

In Energy based Transmission non-zero voltage level is used for both transmission of 0 and 1. They keep both the transmitter and receiver switched on for the entire duration of transmission of data means they use the energy for transmission of every bit of data. E.g. when sensor s1 want to send data 113 to sensor s2. Then s1 send binary bit of 113 that is 111001 to s2. It uses energy for every bit of transmission. Thus energy consumed per bit transmitted is E, the total energy consumption is 7\*E [5,6].

To reduce energy consumption researcher focus on the MAC layer design. Maximum energy waste in MAC layer is because of collision, Overhearing, Control-packet overhead, Ideal Listening, and Overmitting. Main disadvantage of this Energy based Transmission is energy consumption for data transmission is more [7].

### **2.2. Communication through Silence**

Communication through Silence mechanism is completely opposite to Energy based Transmission. In CtS mechanism silent periods are used to transmit information means energy is used only at the transmission of 1 bit and at the transmission of 0 bit no energy is used. For e.g. when sensor s1 want to communicate value 113 with sensor s2. s1 send start signal to sensor s2. After receiving signal from s1, s2 start counting from 0. Sensor s1 knows the counting rate of s2, s1 send stop signal to s2 when s1 count 113 values and this counted value is considered as information transmitted by s1 [4].

Challenges in the design of CtS are Framing, Addressing, Error Control, and Contention Resolution. CtS mechanism gives better performance than the Energy based Transmission. Disadvantage in Communication through silence mechanism is energy throughput trade-off [9].

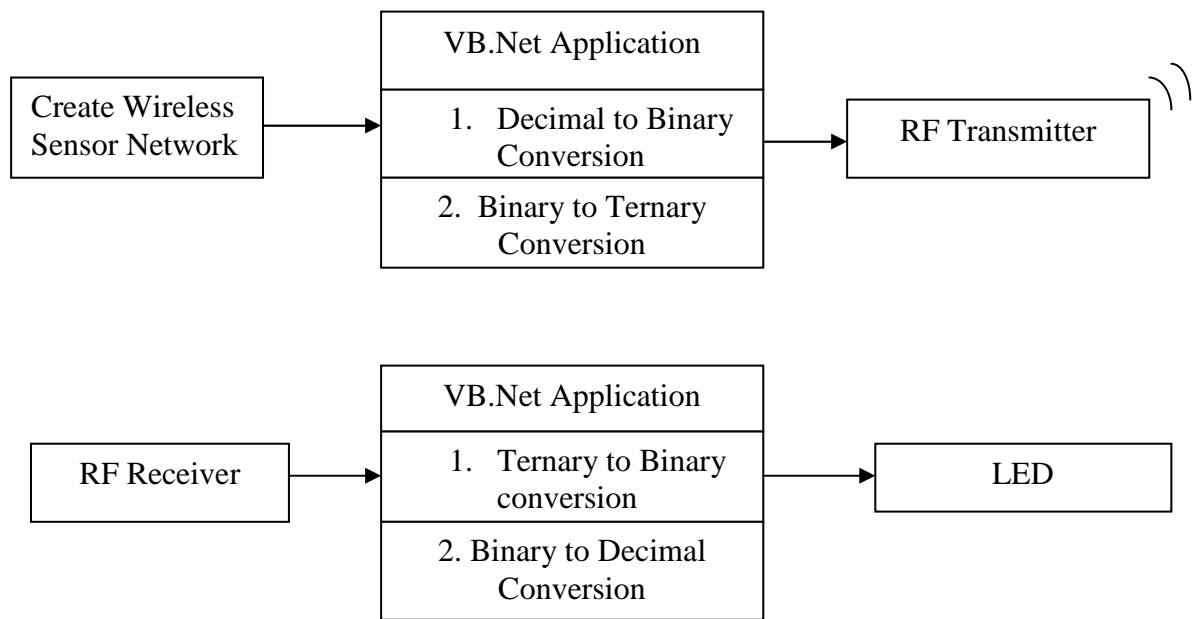


Fig 1: Block diagram for TSS Technique

### 2.3 RBNSiZeCommunication

RBNSiZeComm combine the concept of CtS and VarBaTaC. Conversion of the data to be transmitted to its equivalent redundant binary number (RBN) representation with the strategy of using silence for communicating the digit zero. By using the redundant binary number system (RBNS) that utilizes the digits from the set -1, 0, 1 to represent a number with radix 2, significantly reduce the number of non-zero digits that need to be transmitted. The transmission time remains linear in the number of bits used for data representation, as in the binary number system. For operations in a noisy channel, transceiver uses a hybrid modulation scheme utilizing FSK and ASK to keep the cost and complexity of the radio low [1],[2].

RBNSiZeComm transmission strategy involves the execution of following steps:

1. Recode the binary data frame in RBNS using reduction rules.
2. Send the RBNS data frame, transmitting only the 1 symbol, while remain silent for the 0 symbol.

This scheme save the transmission energy only at the transmitter.

### 2.4 Ternary with Silent Symbol

Koushik Sinha, Debasish Datta proposes a new energy efficient communication scheme for wireless sensor networks that is based on the ternary number system encoding of data called as Ternary with Silent Symbol (TSS) [11].

In this system data is converted from binary to ternary by using silent symbol strategy as shown in figure 1. Aim of this strategy is save the energy

simultaneously both at transmitter and receiver. An efficient algorithm for conversion from binary to ternary and vice versa is used that does not involve any division or multiplication but only addition. Transceiver design uses a hybrid modulation scheme utilizing FSK and ASK to keep both the cost and complexity low. Coupled with the low cost and low complexity of transceiver, these savings clearly demonstrate the usefulness of TSS for low power wireless sensor networks, particularly for multi-hop communications [12].

### 2.5 Variable based Tacit Communication

Variable based Tacit Communication (VarBaTaC) uses a variable coding base to control the trade-off between network throughput and energy is saving. VarBaTaC is used to minimize the delay introduced by CtS. Three MAC protocol are used for VarBaTaC implementation to meet different application need. The MAC protocols are sVarBaTaC (the synchronous MAC), aVarBaTaC (the asynchronous MAC), and eVarBaTaC (the enhancement MAC) to address the hidden terminal problem [4].

## 3. APPLICATIONS

Various application of Wireless Sensor Network are as follows:

1. Area Monitoring
2. Forest Fire Detection
3. Air Pollution Monitoring
4. Industrial Monitoring
5. Waste Water Monitoring

- 6. Agriculture
- 7. Greenhouse Monitoring

#### 4. CONCLUSION

This paper presents survey on energy efficiency techniques in wireless sensor network. Because of difficulties in the replacement of usable batteries, energy efficient communication is very important. Communication through silence is widely use technique and it gives better result than other techniques as well as it save energy at both transmitting and receiving end. Many research issues have been highlighted and directions for future work have been suggested.

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