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Optimization Of Energy Efficient Communication To Improve The Lifetime Of Sensor

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ABSTRACT: This paper describes that improving the life time of sensor by optimizing the energy utilized by the sensor. It is very difficult to replace the battery and also it is very expensive.The energy efficient communication is achieved by choosing the perfect modulation scheme and optimizing the Signal to Noise Ratio. The work also focused on optimal SNR exists for various type of wireless channel.The results show that average energy consumption is minimized and the life time of the sensor is improved.

KEYWORDS: Signal to Noise Ratio, Modulation, fading channel, Average energy Consumption

I. INTRODUCTION

The sensor nodes deployed with many real time application such that temperature monitoring, gas sensing, earth quake monitoring, etc. The main task of the sensor node is sensing the environment and processing the sensing signal and transmit to the server or nearest sensor node. However this sensor node operates by the use of batteries. From the above real time application sensor node must be operate without replacing the battery for a long time. The current research is focused on how to minimize the energy consumption in sensor network. In this paper the proposed work focused on minimization of energy consumption in Wireless Sensor. The aim of the work is to find the total energy for successfully transmitting one bit data over fading channel for that each frame is transmitted until it get successfully received at the receiver side.

The proposed Energy consumption model allows achieving minimization of energy consumption and improving the life time of sensor. In this work the channel considered as fading channel. In general fading is a phenomenon in which the strength of the received signal is varied continuously according to the multipath propagation. Most of the literature work focused on Additive White Gaussian Channel. Here the Energy Efficient Communication is achieved by optimizing the modulation scheme over the fading channel. The optimal Signal to Noise Ratio at which the minimization of energy has done. The work also focused on optimal modulation for improving the life time of sensor. The choice of modulation depends on distance.

II. ENERGY CONSUMPTION MODEL

i) Challenges of Power Consumption

Several essential issues are key to developing low-power wireless sensor applications i.e. efficiently harvesting and storing the energy and also using available energy in the most efficient way without affecting the performance of sensor node.The energy budget mainly depends on modulation scheme, transmission power, and type of the wireless channel and length of the frame.Today this is becoming possible because of the development of ultra-low-power transceiver radio chip. The designed chip works with Micro control unit.

There are several ways of reducing the power consumption of a sensor node

- Use of ad-hoc networks and multi-hop communication

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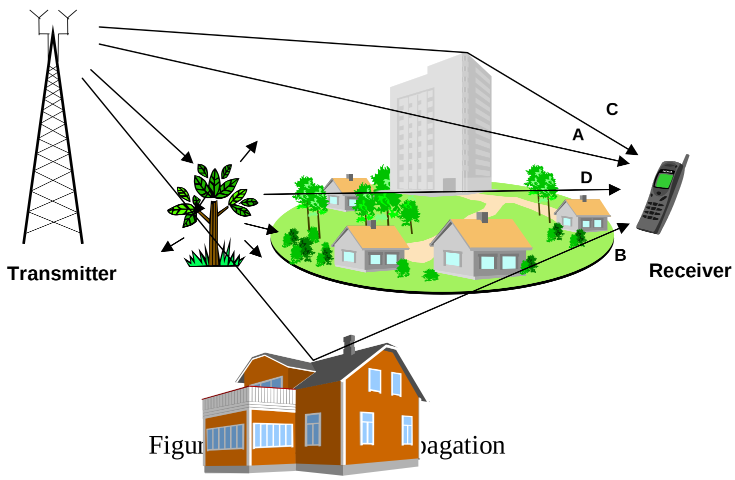
- Trade-off between communication and local computing
- More efficient radio design
- More energy efficient protocols and routing algorithms
- Optimizing the frame length with the help of MAC protocol

Received signal power level is varied as a result of fading environment.

ii) Propagation Mechanism



Figur pagation

The mechanism by which the signal travels shown in the figure 1.1. The signal suffered by multipath effect such that Reflection, Refraction, diffraction etc.

iii) Multipath Effect

i) Reflection occurs when a propagating electromagnetic wave impinges on a smooth surface with very large dimensions compared with the RF signal wavelength (λ).

ii) Diffraction occurs when the propagation path between the transmitter and receiver is obstructed by a dense body with dimensions that are large when compared with λ, causing secondary waves to be formed behind the obstructing body.

iii) Scattering occurs when a radio wave impinges on either a large rough surface.

III. PROPOSED MODEL

In this paper according to the energy consumption model single optimal Signal to noise ratio (SNR) exist for each type of wireless channel is analyzed. The optimal SNR depends on the modulation size and channel statistics. The optimal modulation as a function of distance also analyzed using various statistics and the rules by which choosing of modulation scheme with an irradiated power limited over shortest and longest distance is also studied.

The work also focused on performance of high spectral efficiency such as 64 QAM and low spectral efficiency modulation scheme such as BPSK and QPSK and the performance is compared. The sensor node life time is improved using this proposed method.

IV. SYSTEM DESIGN

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The system design considered with a Different components of energy consumption such that start up energy consumed by the transceiver,

i) Start up energy consumption

Ii) Energy consumption due to Electromagnetic radiation

$E_{PA} = P_{PA}*T_b$ ----------------- (4.1)

iii) Energy consumption of pre transmission

$E_{el,tx}= P_{el,tx}*T_b$ ------------------(4.2)

iv) Energy Consumption of feedback frame

$E_{fb,rx}=(P_{el,rx}*T_{fb})/L$ ------------------(4.3)

v) Energy Consumption due to Retransmission processing

vi) Total energy for successfully transmitted one bit .The energy consumed by the transmitter of forward frames per bit transferred to the receiver without error is given by

$ET = E_{st}+ (E_{el,tx}+ E_{PA}+ E_{fb,rx})\tau$ ------------------(4.4)

The total energy used by the receiver

$ER = E_{st}+ P_{el,rx*}T_b+ (P_{el,tx}+ P_{PA})(T_{fb}/L)*\tau$ ---------------- (4.5)

Hence the total energy needed to transmit one bit successfully can be written as

$E=S + (P_{el}+ P_{PA})\ \bar{T}\tau$ ---------------- (4.6)

The optimal Signal to Noise Ratio for various wireless channels was obtained by using this Energy Consumption model. In effect, the transmission power given in attenuates over the air with path loss and arrives at the receiver with a mean power given by

$P_{rx}=P_{tx}/A*d\hat{}\alpha$ ---------------- (4.7)

Table 4.1 Low Power Device Parameter

Parameter	Description	Value
L	Frame Payload	98 bytes
E_{st}	Start-up energy	0.125 nJ
A	Path-loss coefficient	3.2
A0	Free space path loss	30 Db
$P_{el,tx}$	Tx electric power consumption	112.5 mW
$P_{el,rx}$	Rx electric power consumption	98.2 mW
□	PA efficiency	35%
N_0	Noise power density	-174 dB m/Hz
N_f	Receiver noise figure	10 dB
Ml	Link margin	30 dB
W	Bandwidth	10 kHz
Rs	Symbol rate	10 k Baud
F	Feedback frame length	11 bytes

V. RESULT AND DISCUSSION

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From the proposed method, the energy consumption model that determines the energy consumed per payload bit transferred without error over fading channels. This model shows that single optimal SNR exists for each type of wireless channel and that it depends on, modulation size and channel statistics. Using the SNR as a variable, model allows deriving analytic expressions for the optimal SNR for AWGN, Rayleigh.

5.1 OPTIMAL SNR AT DIFFERENT WIRELESS CHANNEL

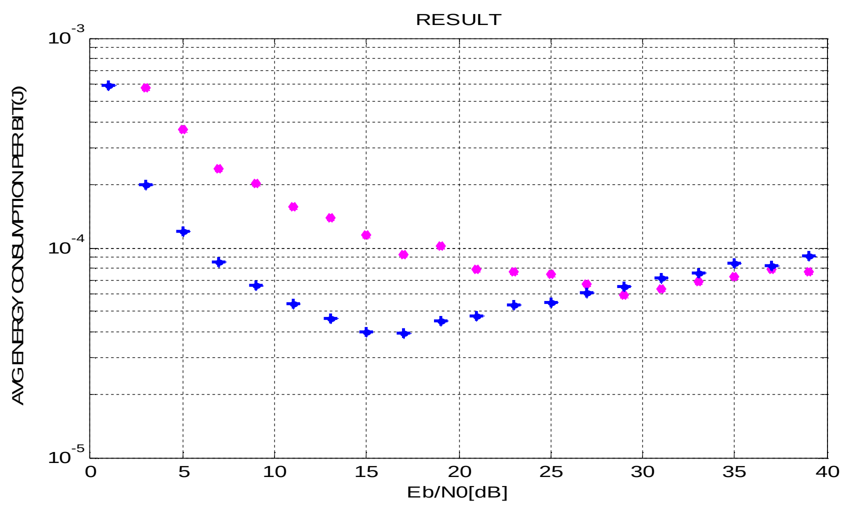

Figure5.1 Average Energy consumption per effective transmitted bit for various fading channel

The above result compares the performance of Rayleigh and Awgn channel. A unique minimum is observed, which corresponds to the optimal Signal to Noise Ratio for maximum energy efficiency. Lower SNR levels are suboptimal because they force the system to do too many retransmissions, and higher SNR levels are also suboptimal because the overall irradiated power is excessive.

The results shows that optimal Eb/No for Rayleigh fading is about 15 dB higher than the one for AWGN, and the minimal energy consumption in Rayleigh fading is twice the minimal consumption in AWGN, when each channel is operated at its optimal mean SNR.

5.2 OPTIMAL MODULATION AND PERFORMANCE COMPARISON

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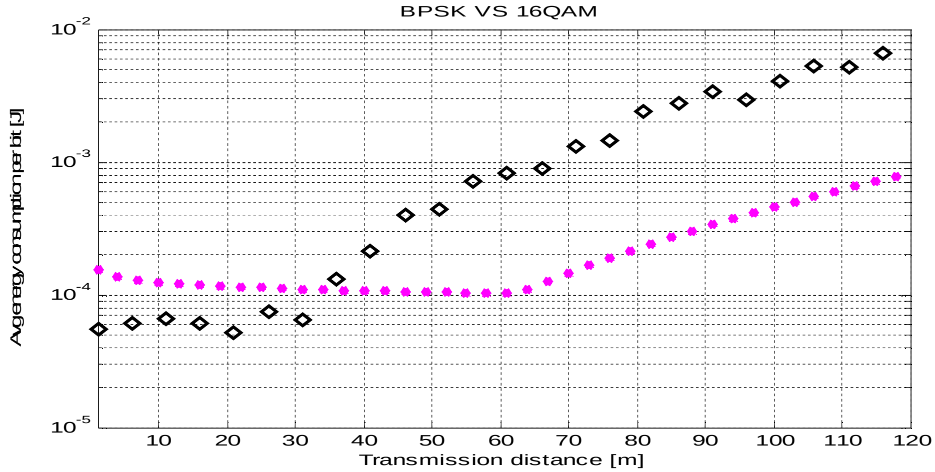

Figure 5.2 Comparison of BPSK modulation with 16 QAM modulations

From the above result (fig 5.2) the energy consumption per bit varies with a increasing oftransmission distance depends on the modulation scheme. However BPSK is a low ordermodulation scheme which is less bandwidth efficient than 16 QAM

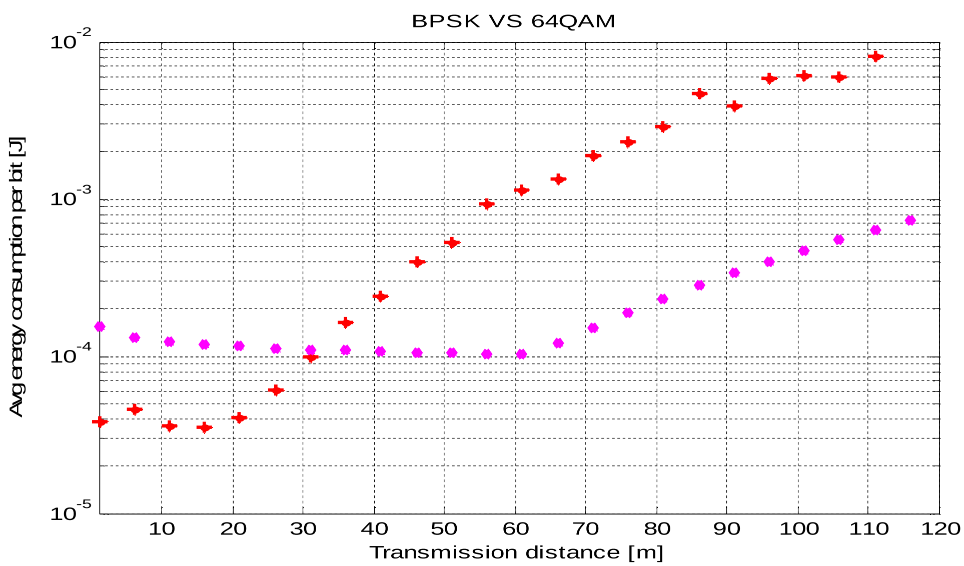

Figure 5.3Comparison of BPSK modulation with 64 QAM modulations

The above results show that high spectral efficiency modulation scheme such as 64 QAM is best choice for short range communication, and the low spectral efficiency modulation scheme is suitable for long distance communication. The energy efficient communication is achieved by selecting the suitable modulation scheme. 64QAM is more spectral efficient than BPSK. In general the system capacity is directly related to the bandwidth efficiency of the modulation scheme, since a modulation with a greater value of symbol will transmit more data in a given spectrum allocation.

5.3 Life Time Analysis

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Lifetime depends on both transmission power and modulation scheme being used. The lifetime of the network is defined as the time until a sensor node drains out of battery energy for the first time, if each modulations is operated at its optimal SNR, BPSK and QPSK are the optimal choices for long transmission distances, but as the transmission distance shortens the optimal modulation size grows to 16-QAM and even to 64-QAM.

Table 5.1Performance Comparison

Method	Type Of Modulation	Energy Consumption(J)
Existing Method	64 QAM	4*10^(-3)
	16 QAM	1*10^(-2)
Proposed Method	64 QAM	4*10^(-5)
	16 QAM	6*10^(-5)
	BPSK	1.5*10(-4)
	QPSK	7*10^(-5)

The above table shows the performance comparison with the existing method. In proposed method the energy minimization is improved.

VI. CONCLUSION

In this work various studied about the improving the lifetime of sensor node.The energy minimization is achieved by optimizing the modulation size with a transmission distance. From the above results for a long transmission distance low spectral efficiency modulation such that BPSK are well suitable. As a distance increase high spectral efficiency 64 QAM is well suitable for increasing the life time of sensor. This energy consumption model also shows that a single optimal SNR exists for each type of wireless channel and that it depends on, modulation size and channel statistics. Using the SNR as a variable, model allows deriving analytic expressions for the optimal SNR for AWGN, Rayleigh. The optimal modulation as a function of distance is obtained and performance analysis over fading channels has been implemented

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