Optimal Energy Allocation for Wireless Communications Subject to Several Energy Constraints

Jyoti M. Giri(Assistant Prof.)
Dhole Patil College Of Engg,pune
Maharashtra, India.

Abstract

Wireless sensor networks used for monitoring an environment. Developers of WSNs face challenges that arise from communication link failures, memory and computational constraints, and limited energy. The goal is to formulate a variety of constraints and limitations in real world systems and the optimal resource allocations for such systems. With the use of energy harvesting technologies, the lifetime of a wireless sensor network can be prolonged significantly. The energy management policy of an energy harvesting WSN needs to take into account the energy replenishment process.

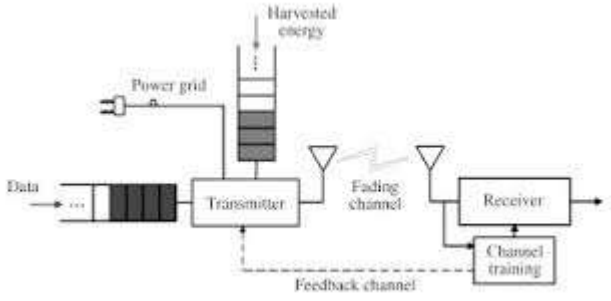
Key Terms:- *Wireless Sensor network, Optimal energy allocation, Energy harvesting, Power Grid etc.*

I. INTRODUCTION

Wireless Sensor networks is one of the new technologies growing very rapidly in the last two decades.WSN is one of the solutions to the challenging problems in various fields, such as Environment, Health, Military, Industrial and Residential applications. The main challenges of WSN are the energy and bandwidth limitations, because in many instances sensor is powered by battery which has limited time life.

Energy harvesting is a promising technology to provide wireless networks with sustainable power supplies. It can overcome the bottleneck of energy constrained wireless networks. The nodes with energy harvesting technology can collect the different kinds of energy from the environment and convert it into usable electric power for the system.
Energy harvesting and management may be the most convenient ways to solve the problem of making WSN autonomous and enable widespread use of these systems in many applications

In traditional wireless networks, nodes get their energy from the power grid by always or periodically connecting to it. While it is easy to connect the terminals to the grid in some Networks, in others, such as sensor networks, it can not be done once after the deployment. Therefore, in such networks a
Nodes lifetime and hence the network lifetime is constrained by the limited initial energy in the battery. To solve this we have to provide the nodes with Energy harvesting capabilities
An Energy harvesting node can scavenge energy from the environment with energy harvesting nodes in the network.



The design considerations of an energy harvesting WSN are different from a non rechargeable battery powered WSN in many ways.
1] With a potentially infinite amount of energy available to the sensor nodes, an energy harvesting WSN can remain functional for a long period of time.
2] The energy management strategy for an energy harvesting WSN needs to take into account the energy replenishment process.
3] The energy availability constraint, which requires the energy consumption to be less than the energy stored in the battery, must be met at all time.

Purpose of energy Harvesting:-

- Increase the field lifetime of the nodes.
- Energy harvesting allows on-site charging of rechargeable batteries, which can be cycled hundreds of times before their performance degrades.
- With proper hardware and energy management, the lifetime can be extended almost indefinitely. For example, a NiMH battery will decrease to 80% of its rated capacity after about 500 full cycles. However, if it is cycled daily at only 10% of its capacity, the lifetime will increase to 5000 cycles, or about 13 years.[1]

Summary of WSN Energy Harvesting

Energy Harvester	Supported WSN Nodes	Can power WSN router nodes?	Applications Served
Solar Powered Enclosure, Solarcraft	All WSN Nodes*	YES	▪ Outdoor monitoring/logging ▪ Environmental monitoring (soil, water, air, climate) ▪ Structural Health Monitoring (bridges, buildings)
Vibration Energy Harvester, Perpetuum	WSN-3226 Only*	NO	▪ Machine Condition Monitoring (motors, equipment, HVAC systems, machinery)

II] OVERVIEW:-

A key determinant of the performance of energy management policies in energy harvesting systems is the efficiency of energy storage. Energy storage units may foster imperfections such as leakage of the available energy and inefficiency due to other physical reasons. In data transmission with hybrid energy storage device, aside from determining the transmit power level, the

transmitter has to decide the portions of the incoming energy to be saved in the Super Capacitor and the battery. While it is desirable to save incoming energy in the Super Capacitor due to its perfect storage efficiency, the storage capacity limitation necessitates careful management of the energy saved in the Super Capacitor. Therefore the extra degree of freedom to choose the portion of incoming energy to save in different storage units significantly complicates the energy management problem. Off line throughput maximization for energy harvesting systems has recently received considerable interest

III] DISCUSSION:-

A Wireless sensor Network is composed of a large number of sensor nodes that are deployed for environmental sensing, monitoring and maintenance. A sensor node is mainly powered by a non-rechargeable battery which has a limited energy storage capacity. As a result a WSN can only function for a limited amount of time. The idea of energy harvesting proposed to address the problem of finite lifetime in a WSN by enabling the wireless sensor nodes to replenish energy from ambient sources, such as solar, wind and vibrations. For transmitters that are powered by energy harvesters the energy that can potentially be harvested is unlimited. typically the energy is replenished by the energy harvester, while expended for communications or other processing; any unused energy is then stored in an energy storage, such as a rechargeable battery. However, unlike conventional communication devices that are subjected only to a power constraint or a sum energy constraint, transmitters with energy harvesting capabilities are in addition subject to other energy harvesting constraints. Specifically, in even time slot, each transmitter is constrained to use at most the amount of stored energy currently available.

IV] CONCLUSION:-

Resource allocation in wireless systems play an important role in increasing the efficiency of the systems by adaptively changing the rate or power of the transmitter according to the channel fluctuations. Wireless Sensor Networks that are powered by ambient Energy harvesting is a promising technology for many sensing applications as this eliminate the need to replace batteries as well as the need for battery disposal

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Author Profile

Jyoti M. Giri Completed her Graduation in Electronics from AISSMS WCOE, Pune , MH, India in 2006. And also completed M.E. (E & TC) from PVPIT Bavdhan , Pune. She is having 3.10 years of industrial experience &5 years of teaching experience. Currently she is working as Assistant Professor in Dhole Patil College of Engineering wagholi, Pune. Her research area include Wireless sensor Network