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# Coverage and Connectivity Issue in Wireless Sensor Networks

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***Abstract***

*Wireless sensor networks (WSNs) are an emerging area of interest in research and development. It finds use in military surveillance, health care, environmental monitoring, forest fire detection and smart environments. An important research issue in WSNs is the coverage since cost, area and lifetime are directly validated to it. In this paper we present an overview of WSNs and try to refine the coverage and connectivity issues in wireless sensor networks.*

***Keywords:*** WSNs, network architecture, coverage, sensor node

## 1. Introduction

In recent years wireless sensor networks (WSNs) has keen interest in research and development due to its wide range of applications. Wireless sensor networks ensure a wide range of applications, starting from security surveillance in military and battlefields, monitoring previously unobserved environmental phenomena, smart homes and offices, improved healthcare, industrial diagnosis and many more. For instance, a sensor network can be deployed in a remote island for monitoring wildlife habitat and animal behavior, or near the crater of a volcano to measure temperature, pressure, and seismic activities.

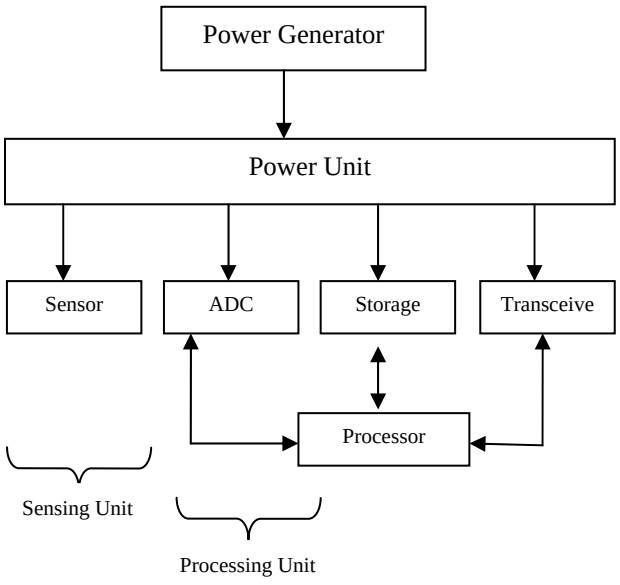


Figure 1. The Component of Sensor Node

In many of these applications the environment can be hostile where human intervention is not possible and hence, the sensor nodes will be deployed randomly or sprinkled from air and will remain unattended for months or years without any battery replacement. Therefore, energy consumption or, in general, resource management is of critical importance to these networks. WSNs provide a viable alternative to several existing technologies. For example, large buildings

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contain hundreds of environmental sensors that are wide to a central air conditioning and ventilation system.

Sensor networks are used to collect sensed data and transmit them to the base station. Sensor node is the heart of the sensor network. In the wireless sensor network each node is typically equipped with microcontroller, transceiver, external memory, power source and one or more sensors. The sensor nodes sense the environment and collect the information and forward this information to other nodes or base station in a wireless manner.

## 2. Coverage and Connectivity

Basic requirement of WSN is coverage and connectivity. Coverage and connectivity are two important properties of WSN. If we talk about the limitations of sensors technology we can easily say that coverage problem affects the quality of service (QoS). The main part of a sensor network is a sensor node which affects directly the size, weight and construction of a network. As the node carries the limitation of battery life, processing and communication the node replacement & battery changing is not possible so we have to adopt particular network or topology which consumes low power.

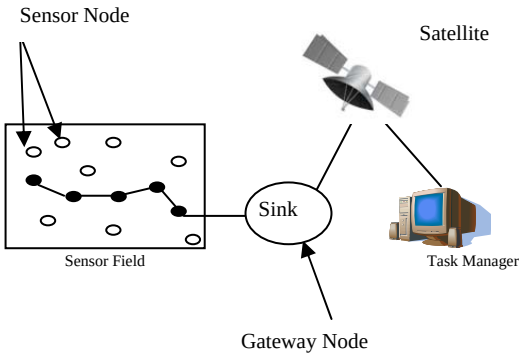


Figure 2. Wireless Sensor Network Architecture

Three types of coverage have been defined by Gage:

1. Blanket coverage — to achieve a static arrangement of sensor nodes that maximizes the detection rate of targets appearing in the sensing field
2. Barrier coverage — to achieve a static arrangement of sensor nodes that minimizes the probability of undetected penetration through the barrier
3. Sweep coverage — to move a number of sensor nodes across a sensing field, such that it addresses a specified balance between maximizing the detection rate and minimizing the number of missed detections per unit area

## 3. Target coverage problem

Target coverage means all the targets should be covered with the objective of maximizing network life time. Possibly, each target is monitored by at least one sensor node while covering the targets, several issues like maximization of network lifetime, minimum participation of sensor nodes, minimum consumption of energy, etc must be taken into consideration in order to achieve must efficient target coverage. Depending upon the energy consumption a sensor can be in one of the following four states: transmit, receive, idle, or sleep. The idle state is when the transceiver is neither transmitting nor receiving, and the sleep mode is when the radio is turned off. An interesting observation is that the receive and idle modes may require as much energy as transmitting, whereas in the traditional ad-hoc wireless networks, transmitting may use as high as twice the power of receiving.

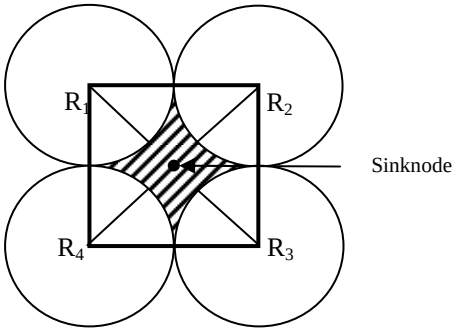


Figure 3. Target Coverage

According to these four states sensors send their location information to the base station and then base station executes the sensor scheduling algorithm and broad casts the schedule when each node is active. Every sensor schedules itself for active/sleep internal.

## 4. Coverage Techniques

Extensive research efforts have been made to develop energy efficient schemes integrating coverage and connectivity for Wireless Sensor Network. Depended on the coverage objectives and applications, they can be roughly classified into three categories: Area Coverage, Point Coverage, and Path Coverage.

### 1) Area coverage:

In Area Coverage the main objective of the wireless sensor network is to cover (monitor) Region of Interest. Each point of the region need to be monitored because complete coverage is desired for valid data otherwise coverage holes exits.

### 2) Point coverage:

In Point Coverage the objective is to cover a set of point (target) with known location that needs to be monitored. The point coverage scheme focuses on determining sensor nodes exact positions. Generally point coverage is special case of area coverage. In area coverage some points remain undetected due to some problem; in such case point coverage is implemented. In some applications, when the network is sufficiently dense, area coverage can be approximated by guaranteeing point coverage. In this case, all the points of wireless devices could be used to represent the whole area, and the working sensors are supposed to cover all the sensors and monitor the target.

### 3) Path coverage:

Path coverage is one of the monitoring examples, where WSNs are deployed to sense a specific path and report possible efforts made by intruders to cross it. In a manual network deployment, the desired level of the path coverage can be achieved by proper placement of the sensors over the area. When it is not possible to deploy the network manually, random deployment is used, for example, dropping sensors from an aircraft. Due to the randomness of the sensors location, network coverage expresses a stochastic behavior and the desired (full) path coverage is not guaranteed.

## 5. Conclusion

Wireless sensor network are totally depends on battery recourses. Coverage of the specific targets is gaining popularity day by day. The coverage issue can be area coverage, target coverage and coverage dealing with maximum support/breach path. Several research works are being carried out on the target coverage problem. In future scope of work, we will design an algorithm for target coverage in order to achieve improved lifetime and minimum energy consumption. Although many schemes have been proposed and progress has been made in coverage problems of WSN, there are still many open research issues. More authentic

model of sensor nodes must be incorporated with the coverage schemes in order to perform various real applications excellently. Effective coverage scheme should be proposed to implement real applications but limited to theoretical study. Therefore, most existing centralized and localized algorithms or protocols.

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