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# A survey on energy efficient coverage protocols in wireless sensor networks



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 Energy efficiency

**Abstract** A Wireless Sensor Network (WSN) is used to monitor an area for events. Each node in the WSN has a sensing range and a communication range. The sensing coverage of a sensor node is the area determined by the sensing range of the sensor node. Sensing coverage of the network is the collective coverage of the sensor nodes in a WSN. Sufficient number of sensor nodes need to be deployed to ensure adequate coverage of a region. Further, since sensor nodes have limited battery life, it is also essential to reduce the energy consumption. This would help improve the network lifetime and thus the coverage lifetime. To reduce energy consumption in the WSN, some of the nodes with overlapping sensing areas could be turned off using a coverage optimization protocol. In this paper, we discuss various coverage optimization protocols. These protocols are broadly classified as *clustering* and *distributed* protocols. Further, these protocols are classified based on the type of sensing model used, node location information, and mechanism used to determine neighboring node information (based on probe or computational geometry). In this paper, we review the key coverage optimization protocols and present open research issues related to energy efficient coverage.

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## Contents

1. Introduction . . . . .	429
2. Preliminaries . . . . .	431
2.1. Sensing models . . . . .	431
2.1.1. Deterministic sensing model . . . . .	431

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2.1.2.	Probabilistic sensing model . . . . .	431
2.2.	Centralized/distributed algorithm . . . . .	431
2.3.	Sensor node deployment strategy . . . . .	431
3.	Coverage optimization protocols. . . . .	432
3.1.	Location unaware distributed protocols . . . . .	432
3.1.1.	Probing environment and adaptive sleeping . . . . .	432
3.1.2.	Probing environment and collaborating adaptive sleeping . . . . .	433
3.1.3.	Controlled layer deployment . . . . .	434
3.1.4.	Random backoff sleep protocol . . . . .	434
3.1.5.	Discharge curve backoff sleep protocol . . . . .	434
3.1.6.	Distributed coverage calculation algorithm . . . . .	435
3.1.7.	Coverage and energy strategy for wireless sensor networks. . . . .	435
3.1.8.	Connected target k-coverage . . . . .	436
3.2.	Comparative analysis of distributed, location unaware, deterministic sensing model and probe based coverage protocols . . . . .	436
3.3.	Location aware distributed protocols . . . . .	437
3.3.1.	Coverage configuration protocol . . . . .	438
3.3.2.	Enhanced configuration control protocol . . . . .	438
3.3.3.	Optimal geographical density control . . . . .	439
3.3.4.	Probabilistic coverage protocol . . . . .	439
3.3.5.	Probabilistic coverage preserving protocol . . . . .	439
3.3.6.	Balanced energy and coverage guaranteed protocol . . . . .	440
3.3.7.	Edge based centroid algorithm . . . . .	440
3.4.	Comparative analysis of distributed, location aware, deterministic sensing model, computational geometry based coverage protocols. . . . .	441
3.5.	Location aware clustering protocols . . . . .	441
3.5.1.	Energy and coverage-aware distributed clustering protocol. . . . .	441
3.5.2.	Area of interest . . . . .	442
3.5.3.	Energy efficient protocol for coverage, connectivity and communication . . . . .	442
3.5.4.	Coverage-aware clustering protocol . . . . .	443
3.6.	Comparative analysis of clustering, location aware, deterministic sensing model and probe based coverage protocols . . . . .	444
4.	Open issues and future research direction . . . . .	444
4.1.	Limited node mobility . . . . .	444
4.2.	Location awareness . . . . .	445
4.3.	Heterogeneous network with obstacles . . . . .	445
4.4.	Optimized wake-up rate of sleeping nodes. . . . .	445
4.5.	Node failure probability . . . . .	445
4.6.	Optimized clustering techniques . . . . .	446
4.7.	Non-uniform distribution of initial battery level of nodes . . . . .	446
4.8.	Coverage degree . . . . .	446
5.	Conclusion . . . . .	446
	Acknowledgment. . . . .	446
	References . . . . .	446

## 1. Introduction

Wireless Sensor Networks (WSNs) have been widely considered as one of the most important technologies for the twenty-first century (Zheng and Jamalipour, 2009; Chong and Srikanta, 2003). A typical Wireless Sensor Network (WSN) (Zheng and Jamalipour, 2009; Chuan et al., 2012; Raghavendra et al., 2011; Akkaya and Younis, 2005) consists of a large number low cost, multi-functional sensor nodes typically operate on limited battery power and are deployed to monitor an area of interest. These sensor nodes are typically small in size with inbuilt micro-controllers and radio transceivers. Thus, sensor nodes have the ability to sense external events, process the sensed data and transmit it. WSNs are

widely used for environmental condition monitoring, security surveillance of battle-fields, wildlife habitat monitoring, etc. (Mulligan and Ammari, 2010). A WSN has the following characteristics:

- **Dense Node Deployment:** Sensor nodes are usually densely deployed in an area to be monitored. The number of sensor nodes in a sensor network is usually higher than that of a MANET (Chlamtac et al., 2003; Hoebeke et al., 2004).
- **Limited Energy Resources:** Sensor nodes are usually powered with small batteries. In certain applications, they are deployed in a harsh or hostile environment, where it would be very difficult or even impossible to replace or recharge the node batteries.

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