Wireless Sensor Networks notes

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Chapter 2

Network deployment

2.1 Overview

Coverage:
Coverage pertains to the application-specific quality of information obtained from the environment by the neworked sensor devices.
Connectivity:
Connectivity pertains to the network topology over which information routing can take place.

2.1.1 basic consideration

Structured versus randomized deployment

The randomized deployment approach is appealing for futuristic applications of a large scale.
However, many small-medium-scale WSNs are likely to be deployed in a structured manner via careful hand placement of network nodes.
Randomized sensor deployment can be even more challenging since there is no way to configure a priori the exact location of each device. Additional post-deployment self-configuration mechanisms are required.
Random Graph Theory in Section 2.4.
Power-based topolgy control techniques in Section 2.5

Over-deployment versus incremental deployment

Robustness vs arising needs. Refer to chapter 7.

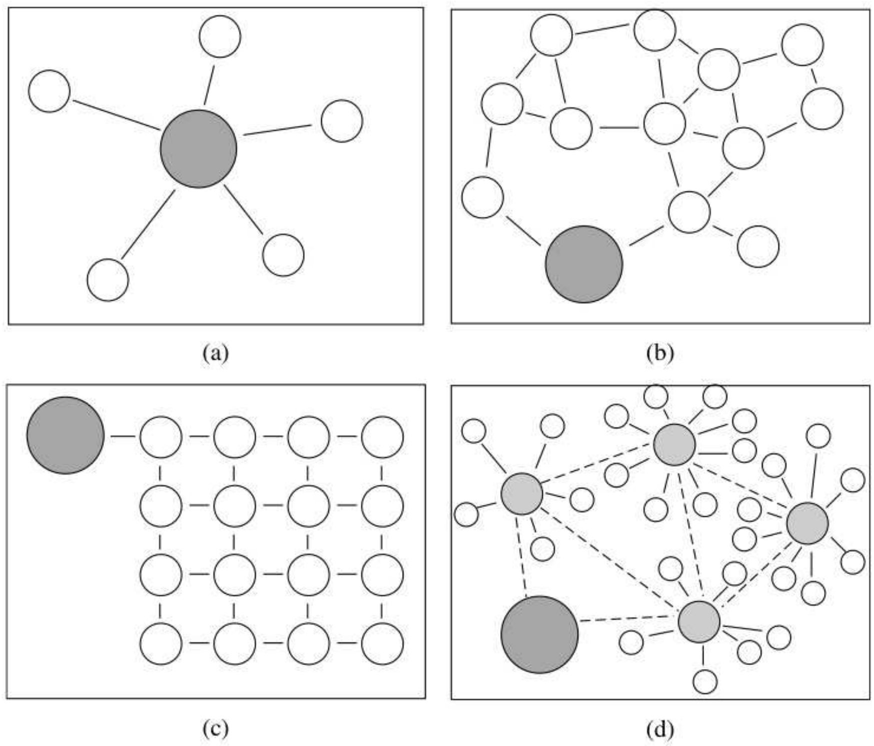

Figure 2.1 Different deployment topologies: (a) a star-connected single-hop topology, (b) flat multi-hop mesh, (c) structured grid, and (d) two-tier hierarchical cluster topology

Figure 2.1: topology

Network topology

Single-hop star
Multi-hop mesh and grid
Two-tier hierarchical cluster

Homogeneous versus heterogeneous deployment

Are all sensor nodes of the same type? If not, there may be multiple gateway/sink devices.

Coverage metrics

What is the kind of sensor information desired from the environment and how is the coverage measured?

2.2 Connectivity in geometric random graphs

A random graph model is essentially a systematic description of some random experiment that can be used to generate graph instances.
The Bernoulli random graphs G(n,p) are formed by taking n vertices and placing random edges between each pair of vertices independently with probability p.
The geometric random graph G(n,R): n nodes are placed at random with uniform distribution in a square area of unit size(more generally, a d-dimensional cube). There is an edge(u,v) between any pair of nodes u and v, if the Euclidean distance between them is less than R.
The geometric random graphs do not show independence between edges.

2.3 Connectivity using power control

2.3.1 Minimum energy connected network construction

2.3.2 Minimum common power setting

2.3.3 Minimizing maximum power

2.3.4 Cone-based topology control

2.3.5 Local minimum spanning tree construction

2.4 Coverage metrics

2.4.1 K-coverage

A field is said to be K-covered if every point in the field is within the overlapping coverage region of at least K sensors.

2.4.2 Path observation

For tracking targets or other moving objects.

Maximal breach distance metric

The path that maximizes the distance between the moving target and the nearest sensor during the target's point of nearest approach to any sensor. Worst-case notion of coverage.

Maximal support distance

The path in which the moving node can stay as close as possible to sensor nodes during its traversal of the covered area. Best-case coverage metric.

Chapter 3

Localization

Characterized as a tuple of the form $\langle S, T, M \rangle$, where S is the spatial location of the measurement, T the time of the measurement, and M the measurement itself.

3.0.3 Localization approaches

Coarse-grained localization using minimal information

Fine-grained localization using detailed information

3.0.4 Coarse-grained localization

Binary proximity

Whether two nodes are within reception range of each other. The reference nodes periodically emit beacons, or the unknown node transmits a beacon.

Centroid calculation

Used when the density of reference nodes is sufficiently high that there are several reference nodes within the range of the unknown node. As for a 2D scenario, the unknown node$\{x_u, y_u\}$ is

$$x_u = \frac{1}{n} * \sum_{i=1}^{100} x_i \tag{3.1}$$

$$y_u = \frac{1}{n} * \sum_{i=1}^{100} y_i \tag{3.2}$$