Chapter 3. System Model

* 1. WRSN model

The environment is constructed in a 20 X 15 square meters indoor environment with *n* wirelessly rechargeable sensor nodes and *m* wireless charging stations. Let be the set of all the wirelessly rechargeable sensor nodes which are randomly distributed in the three-dimensional region, and be the set of all the charging stations. The directional charging stations, each of which can charge a circular area with *R*-radius. The charging station is actually a subset of where is also a set including more than one node. Due to the power transfer efficiency decreases with the power transfer distance, the effective coverage area is limited to a circle with *R*-radius for each directional radiated charging station. The sensor nodes out of this *R*-radius circle cannot receive effective power. One sensor node may be covered by multiple charging stations and receives power from multiple charging stations simultaneously. In order to minimize the number of charging stations and maximum the overall charging capacity, we define a multi-objective optimization problem.

1. (1)

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where is total charging stations cover rate, is the sensor node which is be covered by charging station. A set of *P* is each sensor nodes of receives power from multiple charging stations, *E* is the effectual charging distance, the distance between sensor nodes and charging stations is *d*.

* 1. Wireless charging model

Each charging station has its own effective charging distance. The effective charging distance is defined as the charging power greater than the power consumption of the sensor node. We are based on the wireless charging model provided by the company Powercast as follows:

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| --- | --- | --- |
|  | , | (2) |

where is received power from the charging station to the sensor node. is power which transfer from charging station to the sensor node. is a value of antenna gains of charging station. is a value of antenna gains of sensor node. is a wavelength of RF. *R* is the distance between sensor node and charging station.