

Chapter 2

System Models

In this chapter, we describe the network models and the attack model for the area attack problem under consideration.

2.1 Network Models

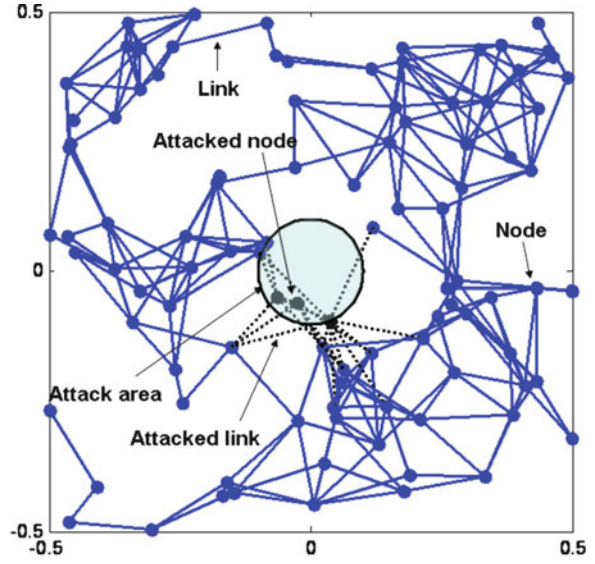
We consider a geographic unit square area \mathcal{W} , i.e., $\mathcal{W} = \{(x, y) : 0 \leq x \leq 1, 0 \leq y \leq 1\}$. In the traditional random network model $G(\lambda, p_r)$ [50], the nodes are randomly distributed in \mathcal{W} with density λ and node pairs are connected randomly with a probability p_r .

In the LCR random network model $G_{LCR}(\lambda, p, l)$, the nodes are distributed randomly in the area \mathcal{W} with density λ . The underlying connectivity graph is formed as: If two nodes are located within a distance l , they are connected to each other with a probability p ; there are no connections between nodes that are located further than l -distance apart. We also assume the periodic boundary condition (PBC) [51] on \mathcal{W} in the LCR random network model to eliminate the boundary effects, i.e., if a node is located at (x, y) , we assume that the node also appears at $(x+n, y+m)$ with $n, m \in \mathbb{Z}$. The effect of PBC simplification will be later discussed. The difference between the LCR random network model and the traditional random network model is that the former one has a range limitation and the latter does not, such that the PBC is not suitable for the traditional random network model. We assume that p and p_r are large enough to maintain a full connectivity for both network models.

2.2 Attack Model

We model the attack area as a circular disk with radius r and center $\mathbf{c}(x_c, y_c)$, where \mathbf{c} is uniformly distributed within \mathcal{W} . We refer to the region being attacked as $\mathcal{A}(\mathbf{c}, r)$, in which all the nodes and links are destroyed. We demonstrate an example of the

Fig. 2.1 A network example,
 $\lambda = 100, l = 0.2, p = 0.5$, and
 $r = 0.1$



LCR random network under an area attack in Fig. 2.1 ($\lambda = 100, l = 0.2, p = 0.5$, and $r = 0.1$), where the disk in the center is the attack area, with the dotted line segments and shadowed nodes touched by the attack area being the destroyed links and nodes.

Network Robustness under Large-Scale Attacks

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2013, VIII, 41 p. 12 illus.,

ISBN: 978-1-4614-4860-0