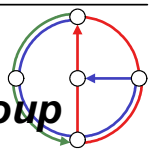
ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Distributed Computing Group



AS 2007 Prof. Dr. Roger Wattenhofer, Nicolas Burri, Pascal von Rickenbach

# Ad Hoc And Sensor Networks
# Exercise 8

Assigned: November 26, 2007
Due: December 3, 2007

## 1 Dominating Sets in Unit Disk Graphs

You have seen different algorithms in the lecture that come up with a Dominating Set (DS) of nodes given an input topology. Thereby a wide range of network models is assumed. In the following you are asked to investigate two DS algorithms presented in the lecture under different network models.

a) The greedy algorithm to compute a DS in arbitrary graphs was discussed in the lecture. It can be shown that the algorithm is $\log \Delta$ approximation in this model. What is the approximation ratio for the greedy algorithm for the UDG model?

b) In the following we consider a Quasi-UDG with $\rho = 1/2$. Additionally, we know the location of the nodes. Provide a local algorithm that computes a Connected Dominating Set (CDS) of the given network. What is your algorithm's approximation ratio?

## 2 Election Algorithms

A lot of algorithms computing dominating sets fall in the class of the so-called election algorithms. One example of such an algorithm you have seen in the lecture is the "Largest ID" algorithm. It was shown that this algorithm has a worst-case complexity of $\Theta(\sqrt{n})$.

a) What happens if we adapt the algorithm in such a way that each node elects its neighbor with the largest degree and node IDs are only used to break ties? Can you find a bad example in which this algorithm produces a large DS?

b) Challenge: Do you find a better selection property that results in a provably good DS for UDG graphs? We do not know the answer to this question so be creative and surprise us with a neat idea :-).

## 3 Application Scenarios

We have seen several algorithms constructing (connected) dominating sets and most of them are reasonably simple to implement. But when does it make sense to apply them? In which of the following scenarios would a (connected) dominating set make the most sense? Give a short explanation.

a) A grid where neighboring nodes are barely in mutual communication range.

b) A dense network with thousands of nodes.

c) A worst case topology where an attacker is allowed to define the topology.

d) A ring topology where each node can reach three nodes on either side.