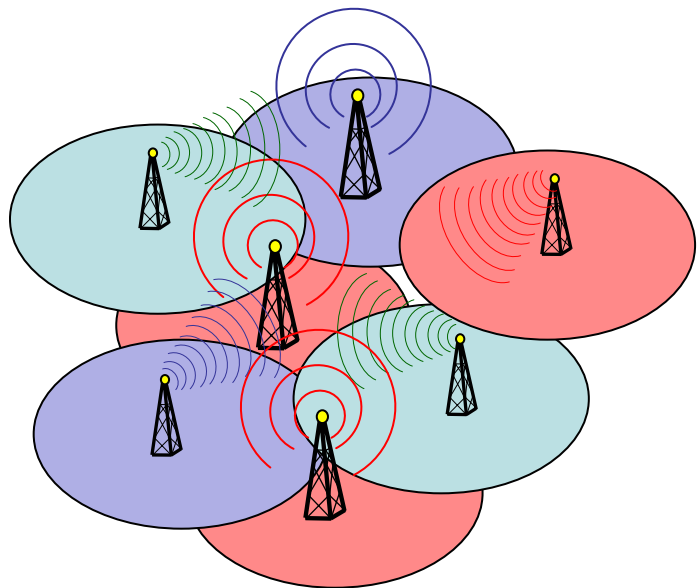


## Diploma/Master Thesis “Frequency Assignment in Cellular Networks”

Cellular networks are heterogeneous networks with two different types of nodes: base stations/antennas (that act as servers) and mobile devices (clients). Clients are connected to base stations by radio links. Fixed frequencies are assigned to base stations to enable links to clients. Clients, on the other hand, continuously scan frequencies in search of a reachable base station. Consider a client that is within the reception range of two base stations. If these two base stations are assigned the same frequency, then mutual interference occurs and the links between the client and each of these conflicting base stations are rendered too noisy to be used. A base station may serve a client provided that the reception is strong enough and that there is no interference with other base stations. The problem of frequency assignment in cellular networks is to assign frequencies to base stations so that every client is served by some base station. The goal is to minimize the number of assigned frequencies because spectrum is limited and costly.



Traditionally, this problem was considered as an application of usual graph coloring. The base stations are the nodes of a graph and two nodes are connected by an edge if the ranges of their associated base stations intersect. If each node (base station) is assigned a color (frequency) such that no two neighboring nodes are colored with the same color, certainly every client can be served by some base station. However in [1], it was shown that this is not the right way to look at the problem since even an optimal coloring may use too many colors. Instead, we have to color the base station's regions such that each point in the plane is covered only once by at least one color. If the sending areas of all base stations are disks of the same radius, it was shown that  $\log(n)$  colors ( $n$  is the number of base stations) always suffice to find such a "conflict-free" coloring. However, there are configurations where the algorithm of [1] needs  $\log(n)$  colors although a small constant (5 in a concrete example) of colors would be enough. Therefore, we are interested in a constant factor approximation, i.e. an algorithm for which the number of colors used is only by a constant factor larger than the number of colors used by an optimal algorithm. The goal of this diploma/master thesis is to work on this problem and hopefully find an algorithm which approximates the problem by a constant factor.

### Skills

- Basic knowledge of Theoretical Computer Science (e.g. “Kernfach Theoretische Informatik”)

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### References

- [1] Guy Even, Zvi Lotker, Dana Ron, and Shakhar Smorodinsky  
Conflict-Free Colorings of Simple Geometric Regions with Applications to  
Frequency Assignment in Cellular Networks  
<http://www.eng.tau.ac.il/~guy/Papers/ELRS.pdf> or  
<http://www.eng.tau.ac.il/~danar/Public/CF.ps>