Cellular Network Map

Real deployment data for cellular networks can be very convenient when elaborating simulation scenarios in scientific papers. In the following, we present an automation tool that enables to extract the geographical data of the base stations for the mobile operators in France.

You need a working python distribution with the following packages:

- selenium
- matplotlib

You also need to have a valid subscription on the ANFR (Agence Nationale des Fréquences) website.

1. Download or fork my repository from GitHub.

2. Launch the crawler script from your command line. The argument of the script corresponds to the postal code as in:

```
python antennes-mobiles-crawler.py 75014
```

You should obtain a text file named `network-map-75014.txt` in the `/data` directory. This file contains information on the antennas in the selected geographical area.

```
66007; 2G 3G 4G; BOUYGUES TELECOM; 1995-09-01; 2014-09-26; 156 R LÉON
MAURICE NORDMANN; 75013; PARIS-13E--ARRONDISSEMENT; Oui;
351124; 2G 3G 4G; BOUYGUES TELECOM; 2004-08-20; 2014-12-05; 22/24 R DU
FAUBOURG ST JACQUES; 75014; PARIS-14E--ARRONDISSEMENT; Oui;
```

The only missing information is the geographic position of the antennas. For this, you need the information from ANFR.

3. Go to ANFR, select the same city as previously and download the data (you should sign in and you will receive data by mail). Download the obtained data in `data/cartoradio-75014/`.

4. Launch the coordinate generation script:

```
python antenna-coordinate-generation.py 75014 orange 4G
```

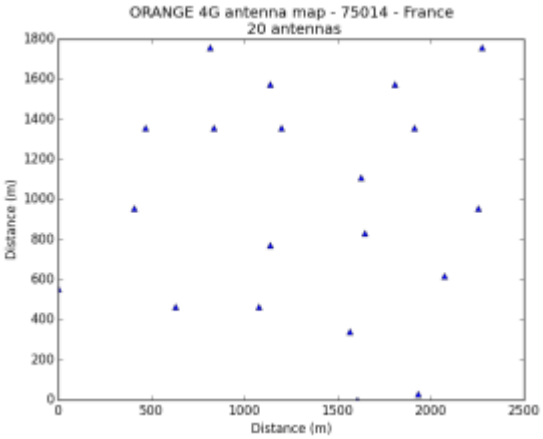
- The first argument is the postal code.
- The second argument is the operator name and must be chosen from: orange - free - bouygues - sfr
- The last argument is the network type: 2G - 3G - 4G

5. Watch back and enjoy!

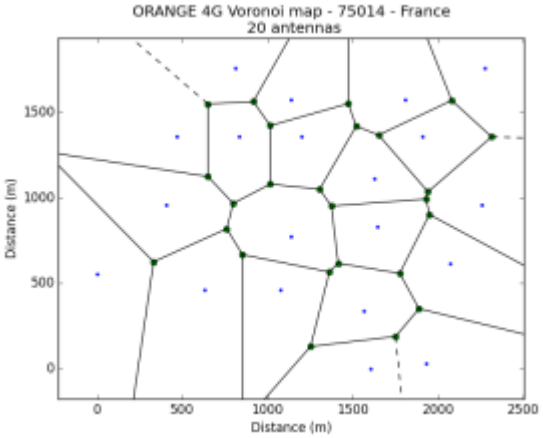
The output of the automation tool consists of three files:

- A command file `75014_ORANGE_4G_antenna_coordinates.m` that contains the coordinates of the antennas. You can simply load this file in MATLAB for your simulations.
- A figure plot of the antenna positions `75014-ORANGE-4G-antenna-map.png`.

- A figure plot of the Voronoi diagram (the set of points in the geographic area closer to each antenna) `75014-ORANGE-4G-voronoi-map.png`.

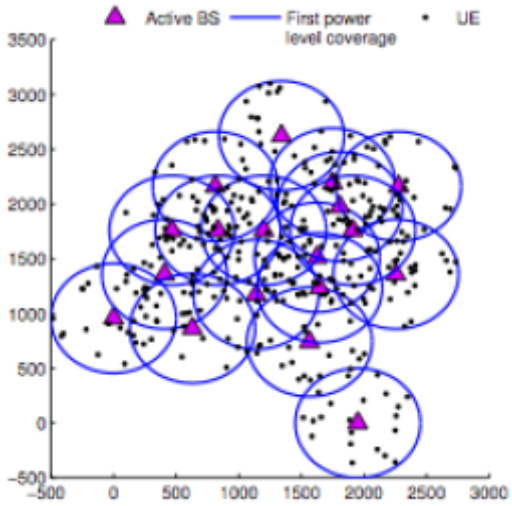


Orange 4G network in Paris 75014



Orange 4G Voronoi map in Paris 75014

We used the antenna positions generated by the automation tool in our work entitled `Joint Power-Delay Minimization in 4G Wireless Networks` (by Farah Moety, Samer Lahoud, Bernard Cousin, and Kinda Khawam), published in the proceedings of the Wireless Days conference (WD'14) in 2014. In this scientific work, we propose an algorithm that aims to compute the transmit power level of the network Base Stations (BSs) and associate users with these BSs. The algorithm aims to jointly minimise the total network power and the total network delay. In the following figure, we show the coverage area of each BS when transmitting at the lowest power level.



Orange 2G network in Rennes (63 BSs)

Orange 3G network in Rennes (69 BSs)

Orange 4G network in Rennes (50 BSs)