Mobile Network

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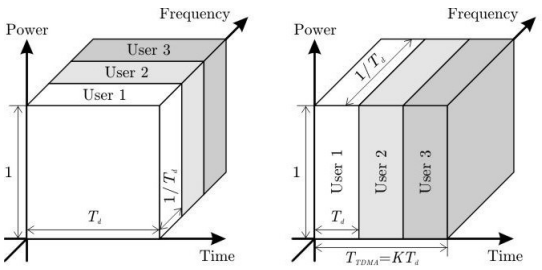
18 avril 2013

1 Multi-User

All the users use the same mean of communication. Indeed phones use a mean of communication shared by everyone. If two phones want to communicate with the same station, they will need to differ from each other. That is why we need multiple access methods. There are three principals Multiple Access Methods.

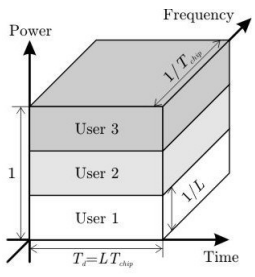
TDMA is the most popular : Phones transmit on the same frequency but each phone has a specific slot.

A second method is FDMA : It is the most flexible and simple method. All users share frequency channel at the same time but each user transmits at single frequency.



FDMA **TDMA**

The third method is CDMA : It uses a spreading code to scramble the data and spread the bandwidth. Multiple stations can transmit on the same frequencies and at the same time. This is possible because the signals are separately encoded and appear to each other to be background noise.



CDMA

FIGURE 1 – Principals Multiple Access Methods

Another issue is Geo-localization. How do a user to know where your mobile phone is when he wants to call you ? This is simple, when you turn on your phone, it will communication with the nearest antenna. This antenna will tell it Mobile-service Switching Center that you are here. The Mobile-service Switching Center will memorise you in it Visitor Location Register and tell your Home Location Register that you are near it.

2 Local Coverage

The local coverage for mobile phone is provided by the cells. The signal received by the phone can be divided in three parts according to the different phenomena which occur (path loss, shadowing, fast fading).

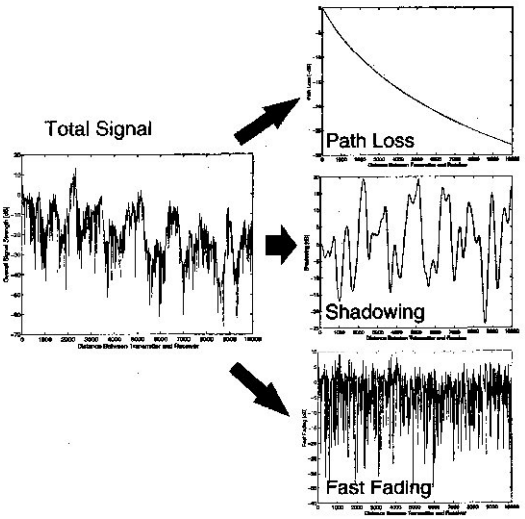


FIGURE 2 – Signal divided in 3 parts

The fast fading is due to the little movement we make with the phone, it produces little variation.

The path loss is the attenuation induce by the distance. The further we are, the strongest the attenuation is. A lot of patterns existed, the differences between them are the numbers of parameters. They are more or less realistic. The less complex pattern is when there is only a line of sight (equation of Friis) and the attenuation is on $1/d^2$.

The last phenomenon is the shadowing, it is the variation due to obstacle between the mobile and the antenna. It is a random phenomenon which depends on the environment.

The gap of power which can emit a mobile and an antenna is quite important. The signal from the mobile is less powerful and so the noise of the channel will affect it more. In some cases, the antenna can contact the mobile but the mobile cannot contact the base, it's a problem of balance radio.

3 National Coverage

In France, there is four main network operator. Those operator are all private company that use the France Telecom network wich is a french public company. The four main operator are Bouygues, Free Mobile, Orange and SFR. They enters into a business agreement with mobile virtual network operator (MVNO)(or mobile other licensed operator (MOLO) in the United Kingdom) to give away bulk access to their network. In order to cover the

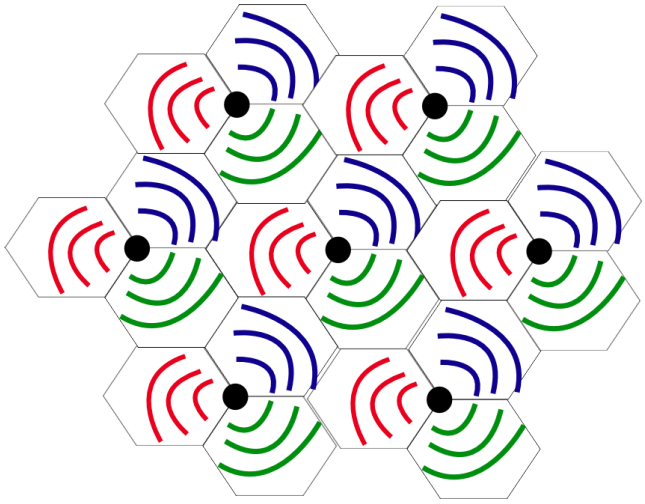


FIGURE 3 – BTS area

whole french territory, BTS come installed with an average of three antennas. Each antenna can manage 500 frequency channels. That mean each BTS can manage 1500 frequency channel and can reach 35km. With only 3 frequency to communicate, BTS have no interference between their three antennas and between them and their congener as you can see on the figure below.

However, those differents frequency channel prevent user's mobile phone from moving from a BTS area to another. That's the reason we invented the hand-over. It is an event that occur when the mobile station change area. The mobile prepare itself and switch frequency depending mainly on the quality of the transmission. The BTS can also ask for a hand over if he is overcrowded.