Power Distribution Analysis of CPICH Channel in a WCDMA Network

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Abstract. This paper shows an analysis of the power distribution of channel CPICH in the WCDMA technology; experimental measurements were used to generate coverage maps with different power levels, allowing us to make the corresponding analysis.

Keywords: CPICH, pilot, WCDMA.

1 Introduction

Today, it is known that there are three generations of mobile communications. The first generation was only an analog network and offered services of voice. Because of the growing demand of services, the systems began to develop, first with the second generation that was a digital network and also of voice, this gave us low data transfer speed. However, it does not meet the communication requirements of today and develop to 3G.

Wideband Code Division Multiple Access (WCDMA) is a technology of third generation mobile communications that increases data transmission rates. WCDMA provides new capabilities of service and lower costs for voice and high-speed data (full-motion video, Internet access and videoconferencing). WCDMA is one technology of Spread Spectrum; this technology spreads the signals over a bandwidth of 5 MHz and it is able to carrying voice and data simultaneously. These features allow a data rate of 384 kbps and a transfer rate in the downlink up of 2Mbps and average processing speed of 22 to 320 Kbps. [1]

The organization of channels used by WCDMA is composed of three layers: physical channel, logical channels and transport channels. Of these channels, the logical describe the type of information to be transmitted, the transport channels described as the logical channels are transferred and the physical channels are means of transmission that provide the radio platform through which information is sent.

The Common Pilot Channel (CPICH) transmits a carrier used to estimate the channel parameters. It is the physical reference for other channels. It is used for power control, transmission and coherent detection, channel estimation, measurement of adjacent cells and obtaining the Scrambling Code (SC). The mobiles use this channel as a reference for deciding when to perform a transfer from one base station to another. The mobile terminals performed a transfer when the signal from another base

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station is above a certain margin of discretion with respect to the received signal. [1-2].

Each base station of WCDMA (Node B) transmits a pilot code; this code makes possible the coherent demodulation, reducing the level of Ec/Io and improves system performance. The pilot code is a pseudorandom sequence, the same for each Node B, but is identified by its sequence of displacement for each Node B. The pilot channel does not carry data, but is used by the user to start the acquisition system, assist in the process of soft handover, synchronization and channel estimation.

2 Measurement methodology

The measurement of the CPICH power is a way of knowing how is distributed the presence of the WCDMA network, the analysis of these power levels; it is possible to determine if the provider's coverage fulfills the customer needs. For a correct analysis of experimental results was necessary to have georeferenced information. To obtain this information, it was necessary to have specialized equipment and generate position information of GPS (Latitude, Longitude, Altitude and Time).

As mentioned, we performed measurements of CPICH power level in the "Lindavista" area. The main focus, was the analysis of the base station "Lindavista" and learns how it is distributed the coverage of WCDMA network of the main operator of the test region. This base station (Node B) with the sectors belonging to the SC 224, 225 and 226 is our central Base Station and platform of our analysis. To perform power measurements, we used a spectrum analyzer, BTS Master MT8222A, Anritsu. Among its features is that it has a GPS receiver, which helped us to locate the measurement point and generate coverage maps georeferenced. In addition, it seems measures the power CPICH of six SC (Scrambling Codes) present at the measured point [3]. The measurements were made by placing the equipment at a height approximately between 1 and 1.5 meters above ground level, simulating the average height at which mobile phone users make use of mobile terminals.

The information of position coordinates was obtained with the spectrum analyzer, it was necessary to configure the equipment and connect the GPS antenna. This feature requires that the equipment get positional information of four satellites for better accuracy.

A total of 1750 measurements distributed along the test site, and use the spectrum analyzer BTS Master MT8222A. In particular, we focus on the power of the CPICH, the analyzer displays in dBm. The distance between measurements was approximately 4 to 5 meters, covering the area of analysis.

With the 1750 point measurements, it was possible to generate coverage maps. The data were processed using software Easy Kriging [4] to implement the Krige geostatistical method (or kriging). . Krige method is an interpolation technique based on regression of samples used to predict unknown values from known values spaced irregularly. The method takes the point values and generates continuous graphic, performing an interpolation of them

It is a geostatistical method that uses a variogram model for data acquisition. The variogram or semivariogram is a tool to analyze the spatial behavior of a variable on a defined area, resulting in the influence of data at different distances.

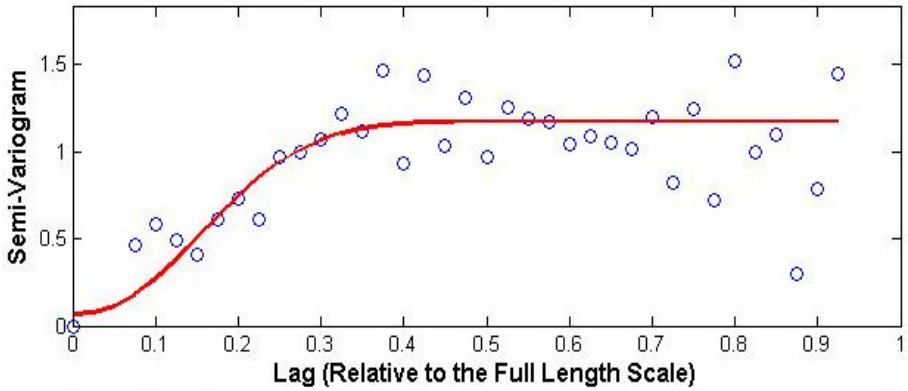

Fig 1. Variogram

Figure 1 shows the variogram generated through of the data, then trying to adjust the variogram, approximating graphics in red on the blue dots; varying parameters model on the right side of the screen. Finally, it generates the coverage map.

2.1 Measurement plan

The first part of the plan of measures was delimiting the area of measurement. This area of work relates to the area covered by the Base Station "Lindavista". **Figure 2** shows the area where measurements were made. In this area we can find different types of scenarios as open area, suburban and urban areas. The model of scenarios open area covers open spaces, without large trees or buildings within the path. In open area the presence of trees is low and building is zero. The suburban area represents some obstacles near of the mobile. This area was chosen because we planed analyze the parameters of the Base Station Lindavista. [3]

2.2 Configuration parameters of WCDMA carrier

The practical parameters of the WCDMA carrier depend of dominant operator in the region of measurement. These operating parameters are:

- Channel: 1087.
- Carrier Frequency: 887.5 MHz.
- Operating Banda: V.

It should be noted that weather conditions affect the values obtained in measurements, so it was necessary that the measurements be made under similar climatic conditions (the sky was not cloudy or partly cloudy, the reason was that the GPS connection is more difficult if the concentration of clouds is large).

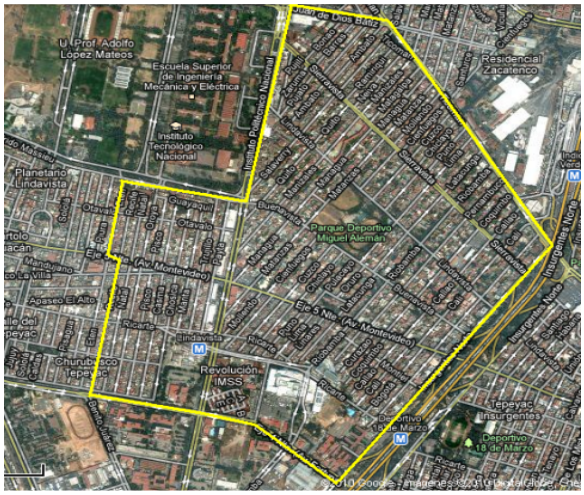

Fig 2. Measurement Area

3 Experimental results

As a first step in obtaining the coverage maps, the experimental results were processed and obtained to a text file to start the interpolation process using the Kriging Easy software. The text file format is shown in Figure 3. The Base Station “Lindavista", presents three SC (Scrambling Codes): 224, 225 and 226. Below is a map (Figure 4) that shows the power levels radiated by each base station sectors of “Lindavista”.

This map allows us to appreciate the coverage areas of each sector. Although the distribution of power is irregular, it does cover with acceptable power levels around the base station. Figure 5 shows the power distribution level of each sector that makes up the base station "Lindavista”. It also shows the color scale used in each of the maps generated.

Whereas the sensitivity of most mobile devices is -80 dBm, can be seen that the levels are acceptable, because in the border areas barely this level is reached.

LONGITUD	LATITUD	CPICH
-99.13472222	19.49777778	-82.553
-99.13472222	19.49777778	-80.167
-99.13472222	19.49777778	-83.676
-99.13472222	19.49805556	-88.068
-99.13472222	19.49833333	-84.118
-99.13472222	19.49833333	-85.757
-99.13472222	19.49833333	-88.932
-99.13472222	19.49861111	-86.631
-99.13472222	19.49861111	-83.616
-99.13472222	19.49888889	-79.743
-99.13472222	19.49916667	-82.326
-99.13472222	19.49944444	-86.039
-99.13472222	19.49972222	-84.787
-99.13472222	19.49972222	-85.6
-99.13472222	19.49972222	-87.987
-99.13472222	19.50027778	-81.967
-99.13472222	19.50027778	-81.457
-99.13472222	19.50083333	-86.443
-99.13472222	19.50083333	-88.63
-99.13472222	19.50111111	-89.686
-99.13472222	19.50111111	-91.257
-99.13472222	19.50166667	-89.88
-99.13472222	19.50166667	-93.867
-99.13472222	19.50166667	-91.075
-99.13472222	19.50166667	-88.946
-99.13472222	19.50194444	-92.528
-99.13444444	19.49583333	-59.089
-99.13444444	19.49583333	-64.401
-99.13444444	19.49583333	-61.553
-99.13444444	19.49583333	-61.553
-99.13444444	19.49583333	-59.87

Fig 3. Text File Format

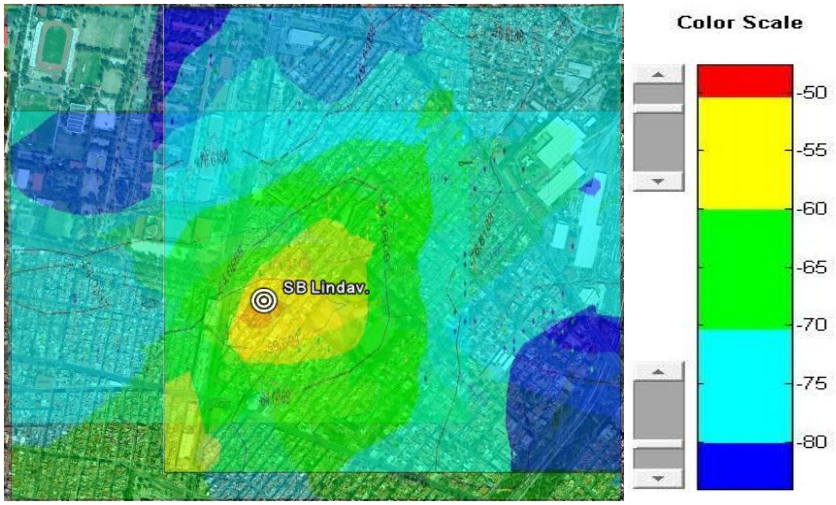

Fig 4. CPICH Power Distribution, “Lindavista” Base Station (dBm)

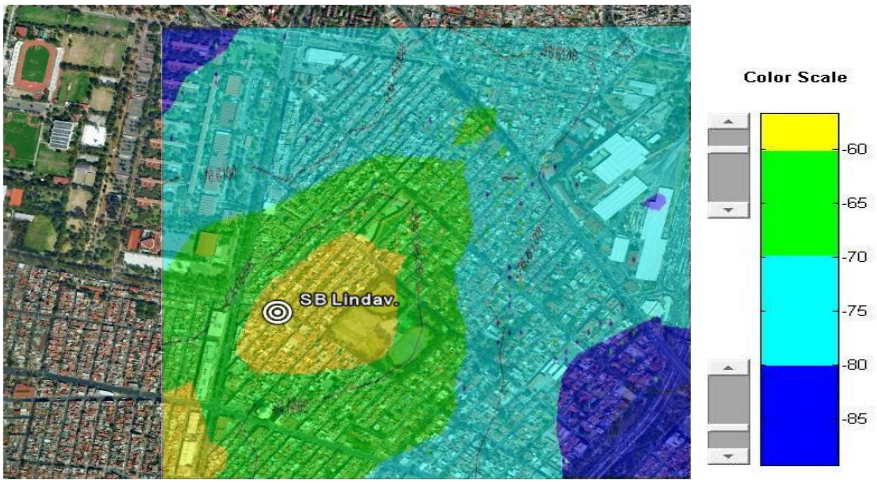

Fig 5. Scrambling Code 224

Fig 6. Scrambling Code 225

4 Conclusions and future work

WCDMA is an idea organized and planned, considering the future, to develop a network that is capable of ensure flexibility in services depending on the needs of users and provide support for service anywhere in the world. WCDMA provides a compromise between coverage and capacity of systems.

The WCDMA network performance can be determined by analyzing several factors, such as: the distribution of CPICH power, multipath, RSCP and the relationship Ec / Io. For purposes of this paper analyzed the distribution of CPICH channel power

The CPICH is a channel that mobile phones used to estimate the fading occurred in the route between the user and mobile.

Fig 7. Scrambling Code 226

The CPICH power level allows us to determine that base station will serve to the mobile terminal, although this doesn't guarantee that the signal that is received is acceptable due to interference. Although the received signal has a power level suitable for that the receiver can recognize the signal, communication can be degraded due to interference, and the transmission rates are reduce.

With the data obtained we can conclude that the base station operates in some respects with minor deficiencies, sometimes the power levels are very high and in some cases very weak. We can also observe a concentration of multiple CPICH pilots in the same area, whose powers are very close together, causing what is known as pilot pollution.

Having a coverage map georeferenced (distribution of radiated power) offers the possibility to know clearly the obstacles that deteriorate the signal quality, areas where the service is received well. The result is to get a general idea about how the Node B is distributing the power of the signal.

Following this line of research, we employ the Krige method to analyze the behavior of the node B under different scenarios to design a propagation model that

considers the particular characteristics of Mexico City for better planning and performance of networks of third generation.

It would be desirable study and analyze the relationship of power and interference, checking the impact that has on the received signals. And also to analyze different scenarios to those presented in this work, for better analysis, considering different materials and environments, and various concentrations of population.

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