Some comparison between propagation models in Cost 2100 Cali Reference Scenario

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ABSTRACT

In this paper we present results from traditional propagation models like Hata and Walfish Bertoni, implemented in our planning tool, and compare it with results obtained from a commercial tool and also with measurements provided by a local operator. For this experiment, we use the Cost 2100 Cali Reference Scenario.

INDEX TERMS

Reference scenarios, propagation models, andean propagation, andean scenarios.

RESUMEN

En el presente artículo se presentan resultados de simulaciones con modelos de propagación tradicionales como Hata y Walfisch-Bertoni, implementados en una herramienta

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de planificación desarrollada por el grupo de investigación, con resultados obtenidos con una herramienta comercial y con medidas proporcionadas por un operador local. Para este análisis se utilizó el modelo de referencia Cali, propuesto en la acción Cost 2100

PALABRAS CLAVE
Modelos de propagación, propagación en entornos andinos, escenarios de referencia, escenarios andinos.

Clasificación Colciencias: Tipo 1

I. INTRODUCTION

We have proposed the Cali Andean reference scenario, with the idea of develop and adapt propagation models in Andean hilly terrain. As was explained in [3] most Countries located in South America have its main cities in Andean regions with huge mountains and dense urban areas. Few works have been done around propagation in these countries [5] and [1], and the effects of such mountains in 4G or Digital Television technologies.

Most operators and consulting companies that deploy wireless systems in South America, use commercial tools with measurements adjusted models, but this approach is expensive and time consuming.

With the recent adoption of the European Digital Television Standard (DVB-T) in Colombia and previously by Uruguay, it is expected that the deployment of DTV networks and in near future, LTE networks requires reliable planning tools and propagation models.

In this work, we show some simulation results from locally implemented propagation models and simulations from a commercial tool widely used in our country, ATDI's ICS Telecom. Initially we only show results from empirical and semi-empirical models, such as Hata and Walfisch-Bertoni, and proprietary implementation of ICS Telecom models based on ITU-R P.526 and Hata modified with Deygout diffraction method. The paper is organized as follows: In section II we make some comments about the set of measurements used, in section III we show results from locally implemented models ; in section IV we show results from ICS Telecom; in section V we present Conclusions and further work .

II. SOME COMMENTS ABOUT MEASUREMENT SET

The measurement set used in this article was obtained from a mobile operator and was based on an extensive measurement campaign made by the operator using COMARCO drive-test equipment and test transmitters located in key sites of Cali. However, some analysis made by our team have detected some errors in this measurement set. At the beginning, we have thought that the problems were related to coordinate translations from WGS84 to UTM, but, as can be seen in Figure 1 , there are a problem with measurement coordinates at the left of image.

In order to correct the problem, we are using a subset of measurements, corresponding to a 2 square kilometre surrounding the transmitter, as illustrated in Figure 2.

III. RESULTS FROM LOCALLY IMPLEMENTED MODELS

We have implemented a basic version of Hata model, with clutters and Walfisch-Bertoni model, in our locally developed tool, CellGIS. This is fundamentally a research and classroom tool used to evaluate classic propagation models and to research about adaptation of propagation models to Andean conditions.

Simulation parameters used to simulate corresponds to Plaza Caicedo site and is presented in Table 1. Operating frequency was 850MHz.

Figure 1. Measurements over Google earth

Figure 2. Filtered measurements

Table 1. Transmitter parameters for simulations

Dec_lat.	Dec-Long.	ERP(dBm)	Antenna	Heigth
3,45155	-76,53322	48,5	BCD8007	36m

In Figure 3 the transmitter location is shown in Google earth image, and Figure 4 we show simulation results for Hata model. When we compare results with measurements, we obtain that 84% of the simulation results have a difference with measurements lower than 14dB, in accordance with typical implementations of Hata model. In Table 2 we show the mean and standard deviation for the differences between measurements and results obtained from Hata model Simulation. It can be noted that the mean difference is very low and standard deviation is according to most reported data.

Table 2. Mean and standard deviation for differences between measurements and hata simulation

Mean	Standard Dev.
-1.2257	16.0771

Figure 3. Transmitter site location in Google earth

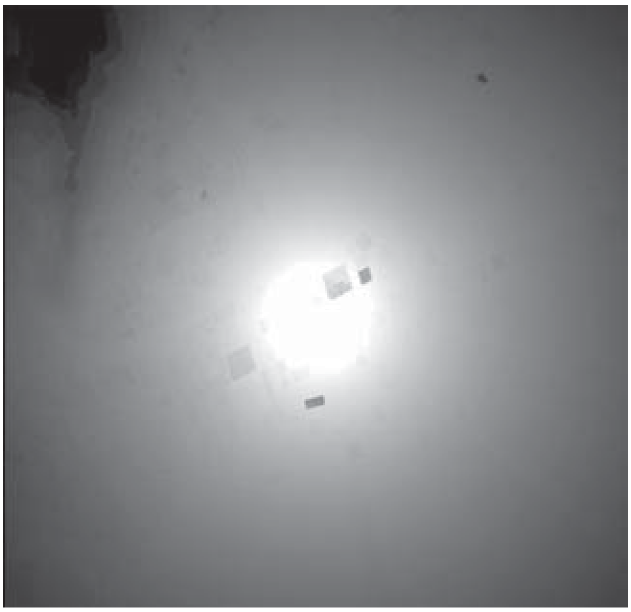

Figure 4. CellGIS Hata results

For Walfisch-Bertoni model [4] and [2], simulation results are shown in Figure 5. Results for this model are very far from typical implementations. When we compare results with measurements, we obtain that only 71% of the simulation results have a difference with measurements lower than 14dB, which differ considerably from reported results. We haven´t identified yet the causes of such differences. In Table 3 we show the mean and standard deviation of the difference between measurements and simulation for the Walfisch-Bertoni model.

Table 3. Mean and Standard deviation for difference between measurements and Walfisch Bertoni model implemented in CellGIS

Mean	Standard deviation
- 11.8749dB	20.4dB

This results shows that Walfisch-Bertoni model is quite optimistic than real measurements, contrary to most reported implementations of the model.

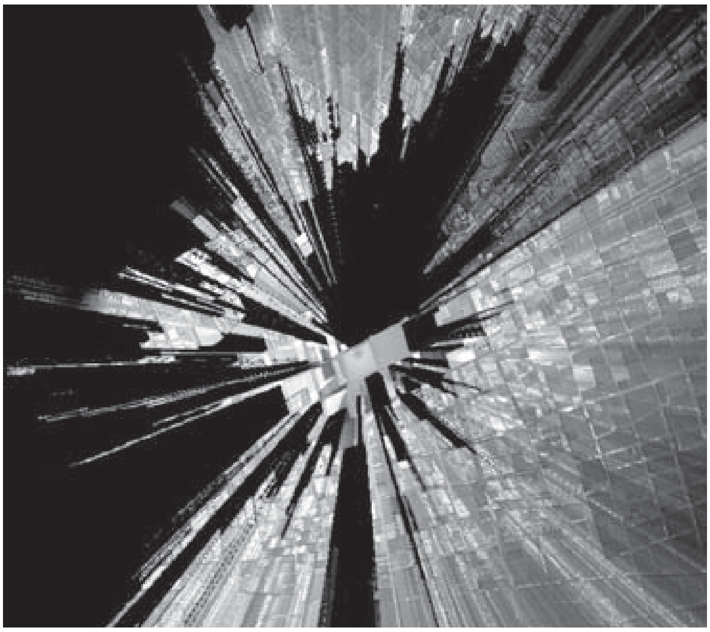

Figure 5. CellGIS Walfisch-Bertoni results

IV. RESULTS FROM COMERCIAL TOOL

As mentioned earlier, we run the simulations using a commercial tool, ICS Telecom v.9. This tool allows us to use models like Hata with diffraction components and it implements proprietary models based in ITU-R recommendations [6].

For this paper, simulation using Hata model with deygout diffraction were run. Simulation results are shown in Figure 7.

Also, simulation using ITU-R P.526 recommendation, were executed with ITU-R P.526 diffraction. Results are shown in Figure 6.

Qualitatively, we can observe than simulation image is quite similar between ITU-R 526 and CellGIS walfisch-Bertoni.

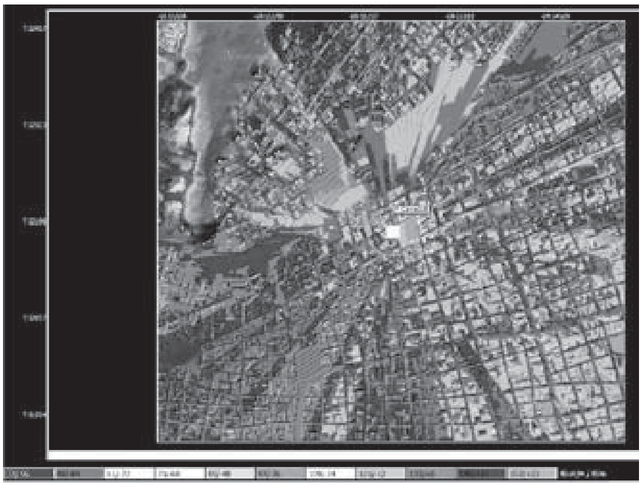

Figure 6. Plaza Cayzedo, ITU-R P.526 model

Comparison between measurements and ICS Hata deygout model shows that 19% of the simulation results have a difference below 14db from measurements.

In Table 4 we show the mean and standard deviation of the difference between measurements and simulation for the Hata - Deygout model implemented in ICS.

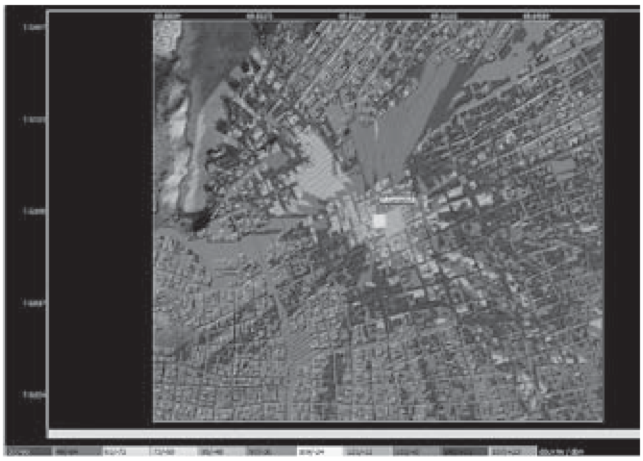

Figure 7. Plaza Cayzedo results using Hata-Deygout model

From these results, we can observe that propagation models implemented in commercial tools have a high error, depending on configuration and terrain.

Table 4. Mean and Standard deviation between simulation in ICS and measurements

Mean	Standard deviation
63.206dB	30.86dB

V. CONCLUSION AND FURTHER WORK

This is an initial work that pretends to analyze the behavior of propagation models in Andean terrain, using the Cali Reference Scenario.

Andean scenarios represents an important challenge for the development and adaptation of propagation models for future wireless systems.

The main goal of the experiment was to compare academic implemented models with commercial tools and to analyze differences between results and the reasons behind those differences.

From the results obtained, it is quite necessary to modify and adapt both commercial models and CellGIS implemented models as has been suggested in some literature. Also, it is necessary to verify measurements coordinates in some areas.

As a further work, we also expect to implement deterministic models in outdoor environments and more precise models reported in literature, in order to improve the accuracy of results.

VI. REFERENCES

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