Scrutiny of Wimax Los and Nlos Based On Ofdm

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Abstract: Worldwide Interoperability of Microwave Access (WiMAX) has potential success in its line-of-sight (LOS) and non line-of-sight (NLOS) conditions which operating below 11 GHz frequency. There are going to be a surge all over the world for the deployment of WiMAX networks. Estimation of path loss is very important in initial deployment of wireless network and cell planning. The wireless channel is modeled as a sum of paths. The wireless channel is modeled as a sum of paths. When the paths represent reflections, the path-strengths depend on the distances traveled and on the reflection coefficients.

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Introduction

WiMAX physical layer consist of OFDM that offer good resistance to multipath. It permits WiMAX to operate NLOS scheme [1]. Nowadays OFDM is highly understood for mitigating multipath for broadband wireless [2]. In this paper we compare and analyze path loss Ericsson model in urban and suburban and rural environments in different receiver antenna heights. This technology is based on Orthogonal Frequency Division Multiplex (OFDM) technology and considers the radio frequency range up to 2-11 GHz and 10-66 GHz [3, 4]. Propagation condition under NLOS is possible by using OFDM, which opens the possibility of reliable and successful communication for wireless broadband [5]. An important feature is an adaptive modulation technique, which depends on Signal to Noise Ratio (SNR). It ensures transmission during difficult condition in propagation or finding weak signal in the receiver-end by choosing a more vigorous modulation technique [6]. Broadband Wireless Access (BWA) systems have potential operation benefits in Line-of-sight (LOS) and Non-line-of-sight (NLOS) conditions, operating below 11 GHz frequency. During the initial phase of network planning, propagation models are extensively used for conducting feasibility studies [7, 8].

Physical layer

physical layer of 802.16 is based on the use of OFDM, which is used to combat frequency selective fading and to randomize the burst errors caused by a wideband-fading channel. A number of data and pilot symbols are transmitted in parallel in the form of one OFDM symbol. In order to prevent Inter-Symbol Interference (ISI), a guard interval is implemented by means of a cyclic prefix. When the guard interval is longer than the excess delay of the radio channel, ISI is eliminated. The physical layer provides several modes, each following different coding and modulation. Line-of-sight (LOS) is a condition where a signal travels over the air directly from a wireless transmitter to a wireless receiver without passing an obstruction. LOS is an ideal condition for a wireless transmission because the propagation challenge only comes from weather or atmospheric parameters and the characteristic of its operating frequency. In LOS environment, signal can reach longer distance with better signal strength and higher throughput. WiMAX consist of OFDM technology which handles the NLOS environments. Normally NLOS refers to a radio path where its first Fresnel zone was completely blocked. WiMAX products can deliver broad bandwidth in a NLOS environment comparative to other wireless products.

Path Loss Models

- Free Space Path Loss Model (FSPL)
- Okumura Model
- COST 231 Hata Model
- Stanford University Interim (SUI) Model
- Hata-Okumura extended model or ECC-33 Model
- COST 231 Walfish-Ikegami (W-I) Model
- Ericsson Model :

Ericsson Model

To predict the path loss, the network planning engineers are used a software provided by Ericsson company is called Ericsson model. This model also stands on the modified Okumura-Hata model to allow room for changing in parameters according to the propagation environment. Path loss according to this model is given by [2]:

$$PL = a_0 + a_1.log_{10}(d) + a_2.log_{10}(h_b) + a_3.log_{10}(h_b).log_{10}(d) - 3.2($$
$+ g(f)$

$$g(f) = 44.49log_{10}(f) - 4.78(log_{10}(f))^2$$

and parameters

f: Frequency

h_b: Transmission antenna height

h_r: Receiver antenna height

Table 1. *Values of parameters for Ericsson mode.*

Environment	*a0*	*a1*	*a2*	*a3*
Urban	36.2	30.2	12.0	0.1
Suburban	43.20*	68.93*	12.0	0.1
Rural	45.95*	100.6*	12.0	0.1

The value of parameter a0 and a1 in suburban and rural area are based on the Least Square (LS) method.

Analysis of simulation results in urban area

The accumulated results for urban environment are shown in Figure1. Note that Ericsson model showed the lowest prediction (142 dB to 138 dB) in urban environment. It also showed the lowest fluctuations compare to other models when we changed the receiver antenna heights.In our calculation, we set 2 different antenna heights (3 m and 10 m) for receiver, distance varies from 250 m to 5 km and transmitter antenna height is 30 m. The numerical results for different models in urban area for different receiver antenna heights are shown in the Figure.1 and Figure.2

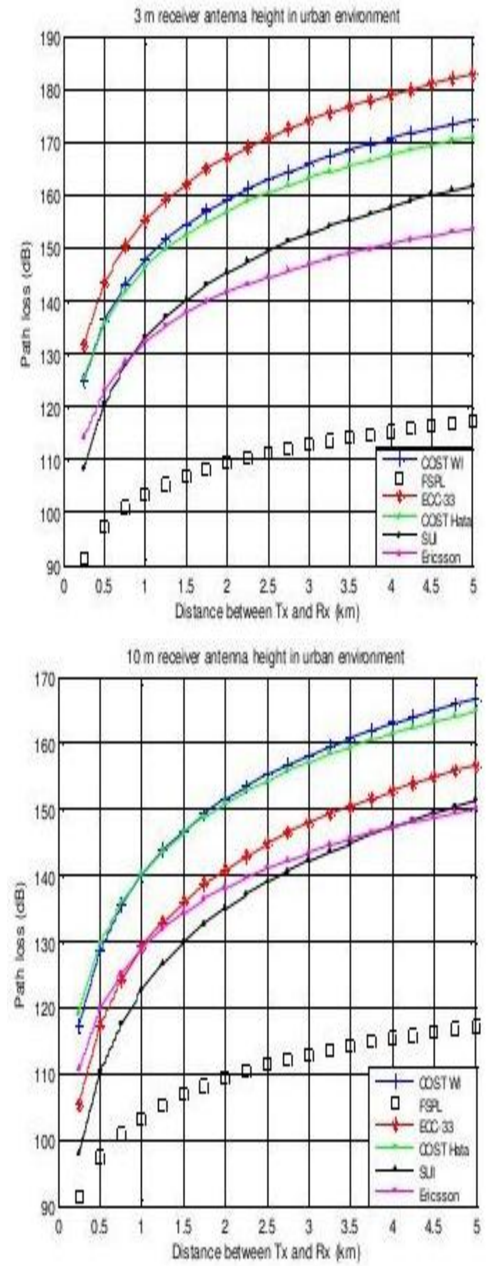

Figure 1 and 2. *Path loss in urban environment at 3m and 10m receiver antenna height.*

Path loss in suburban area

The transmitter and receiver antenna heights are same as used earlier. The numerical results for different models in suburban area for different receiver antenna heights are shown in Figure 3 and Figure 4.The accumulated results for suburban environment , it showed that the SUI model predict the lowest path loss (121 dB to 115 dB) in this terrain with little bit reflections at changes of receiver antenna heights. Ericsson model showed the heights path loss (157 dB and 156 dB) prediction especially at 10m receiver antenna height. The COST-Hata model showed the moderate result with remarkable fluctuations of path loss with-respect-to antenna heights changes. The ECC-33 model showed the same path loss as like as urban environment because of same parameters are used in the simulation.

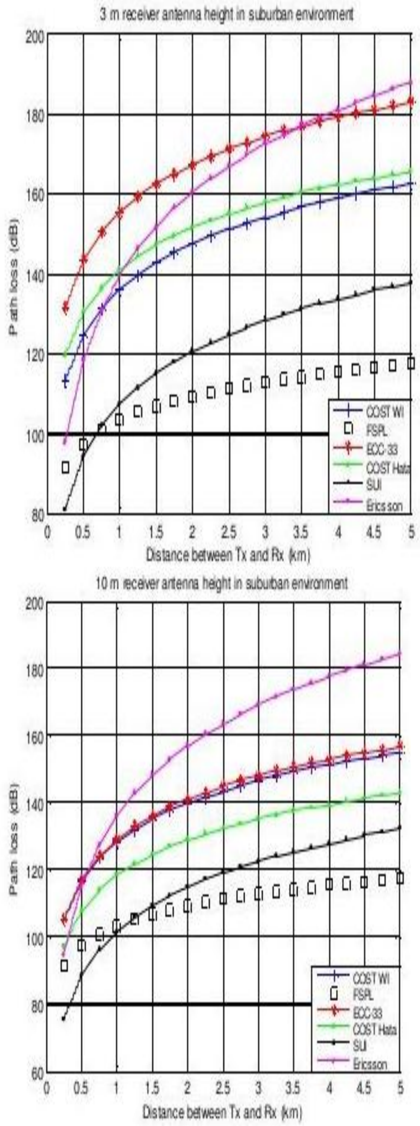

Figure 3 and 4. Path loss in suburban environment at 3m and 10m receiver antenna height

Path loss in rural area

The receiver antenna heights are same as used earlier. Here we considered 20 m for transmitter antenna height. The ECC-33 model is not applicable in rural area and the COST 231 W-I model has no specific parameters for rural area, we consider LOS equation provided by this model. The numerical results for different models in rural area for different receiver antenna heights are shown in Figure 5 and Figure 6.

The accumulated results for rural environment in this environment COST 231 Hata model showed the lowest path loss (129 dB) prediction especially in 10 m receiver antenna height and also showed significant fluctuations due to change the receiver antenna heights. COST 231 W-I model showed the flat results in all changes of receiver antenna heights. There are no specific parameters for rural area. In our simulation, we considered LOS equation for this environment (the reason is we can expect line of sight signal if the area is flat enough with less vegetation's. Ericsson model showed the heights path loss (173 dB to 168 dB) which is remarkable, may be the reason is the value of parameters *a0* and *a1* are extracted by the LS methods.

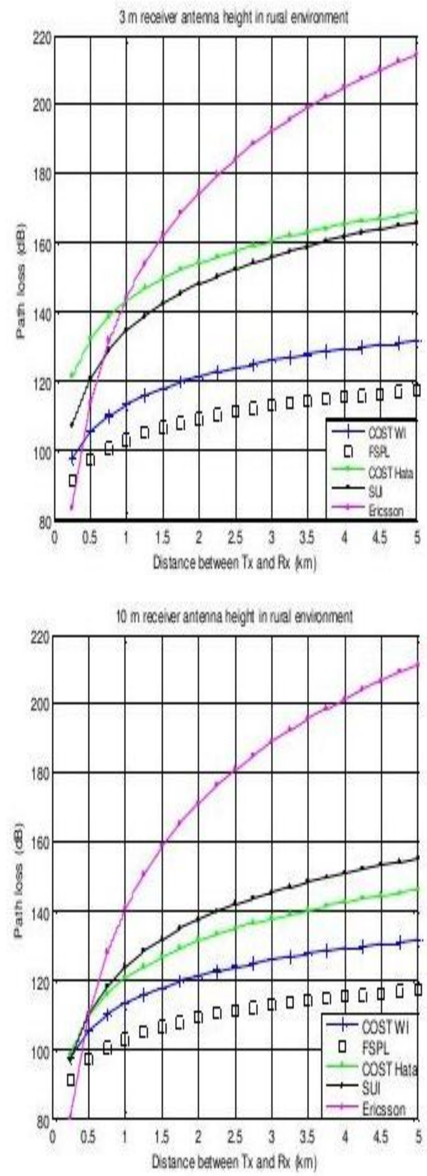

Figure 5 and 6. Path loss in rural environment at 3m and 10m receiver antenna height

Conclusions

We can see in urban area, the Ericsson model showed the lowest path loss as compared to other models. In suburban area the showed quite less path loss compared to other models, On the other hand showed heights path loss as showed in urban area. In rural area, if the area is flat enough with less vegetation, where the LOS signal probability is high, in that case, we may consider LOS calculation. Alternatively, if there is less probability to get LOS signal, in that situation, we can see Ericsson model height. But considering all receiver antenna heights less path loss higher path loss .Some users may be out of signal in the operating cell especially during mobile condition. So, we have to trade-off between transmission power and adjacent frequency blocks interference while choosing a path loss model for initial deployment.

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