Analysis Of Wimax Connectivity In Rural And Urban Area Using Propagation Model

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Abstract

Worldwide Interoperability of Microwave Access (WiMAX) technology becomes popular and receives growing acceptance as a Broadband Wireless Access (BWA) system. Estimation of path loss is very important in initial deployment of wireless network and cell planning. Since site measurements are costly, propagation models have been developed as suitable, low-cost, and convenient alternative. In this for WiMAX network we calculate the connectivity coverage and propagation path loss by using propagation model. Application is giving a possibility to plan radio cells into the map uploaded from the file to provide maximum coverage with minimum number of transmitters in pointed localization.

Keywords: *WiMAX, Coverage Area, Propagation Model, Free Space Path Loss(FSL),Cost 231 - Hata Model*

1. Introduction:

WiMAX stands for Worldwide Interoperability for Microwave Access .It is based on IEEE 802.16 standards. In this technological world, we have so many technologies that help us in every aspect of our daily life such as transportation, communication etc. WiMAX Technology is also one of the emerging wireless technologies that provide us high speed mobile data and telecommunication services.

The Institute of Electrical and Electronics Engineers (IEEE) 802 committee, which sets networking

standards such as Ethernet (802.3) and Wi-Fi (802.11), has published a set of standards that define WiMAX. IEEE 802.16-2004 (also known as Revision D) was published in 2004 for fixed applications; 802.16 Revision E (which adds mobility) is published in July 2005. The WiMAX Forum is an industry body formed to promote the IEEE 802.16 standard and perform interoperability testing.. WiMAX is supported by the industry itself, including Intel, Dell, Motorola, Fujitsu, AT&T, British Telecom, Reliance Infocomm, Siemens, and Tata Teleservices – forming an alliance called WiMAX Forum. It represents the next generation of wireless networking.

Features of WiMAX:

It provided an enhanced set of features with flexibility in terms of potential services. Some of them are highlighting here:

Interoperability:

Interoperable is the important objective of WiMAX. It consists of international, vendor-neutral standards that can ensure seamless connection for end-user to use their subscriber station and move at different locations.

High Capacity:

WiMAX gives significant bandwidth to the users. It has been using the channel bandwidth of 10 MHz and better modulation technique (64-QAM). It also provides better bandwidth than Universal Mobile Telecommunication System (UMTS) and Global System for Mobile communications (GSM).

Wider Coverage:

WiMAX systems are capable to serve larger geographic coverage areas, when equipments are operating with low-level modulation and high power amplifiers. It supports the different modulation technique constellations, such as BPSK, QPSK, 16-QAM and 64-QAM.

Non-Line-of-Sight Operation:

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.

Flexible Architecture:

WiMAX provides multiple architectures such as Point-to-Multipoint, Ubiquitous Coverage, Point-to-Point.

OFDM-based Physical Layer:

WiMAX physical layer consist of OFDM that offer good resistance to multipath. It permits WiMAX to operate NLOS scheme.

Very High Peak Data Rate:

WiMAX has a capability of getting high peak data rate. When operator is using a 20 MHz wide spectrum, then the peak PHY data rate can be very high as 74 Mbps. 10 MHz spectrum

operating use 3:1 Time Division Duplex (TDD) scheme ratio from downlink-to-uplink and PHY data rate from downlink and uplink is 25 Mbps and 6.7 Mbps, respectively.

Quality of Service Support:

WiMAX MAC layer has been designing to support multiple types of applications and users with multiple connections per terminal such as multimedia and voice services. The system provides constant, variable, real-time, and non-real-time traffic flow.

2. Propagation model:

Propagation models are used for calculation of electromagnetic field strength for the purpose of wireless network planning during preliminary deployment. It describes the signal attenuation from transmitter to receiver antenna as a function of distance, carrier frequency, antenna heights and other significant parameters like terrain profile (e.g. urban, suburban and rural).

For wireless communication system, the system should have the ability to predict the accurateness of the radio propagation behaviour. Thus it has become pivotal for such system design. The site measurements are expensive and costly. Propagation models have been developed as low cost, convenient alternative and suitable way. In wireless communication systems information is transmitted between the transmitter and the receiver antenna by Electromagnetic waves. During Path loss (PL) is defined as the difference between transmitted and received power (in dB) as shown in

$$PL=P_T+G_T+G_R-P_R-L_T-L_R \quad [dB] \quad \ldots\ldots\ldots \quad (1)$$

Where P_T and P_R are transmitted and received power, G_T and G_R are the gain of transmitting and receiving antenna, respectively, and L_T and L_R are feeder losses. There are two main types of models for characterizing path loss: deterministic (site-specific theoretical) and empirical (statistical) models. Empirical models are based on measurements and predict mean path loss as a function of various parameters, e.g. antenna heights, distance, frequency, etc. Empirical models are easier to implement, with less computational cost, but they are less accurate.

2.1 Free Space Path Loss Model (FSPL): Path loss in free space *PLFSPL* defines how much strength of the signal is lost during propagation from transmitter to receiver. FSPL is diverse on frequency and distance. The calculation is done by using the following equation:

PL (FSPL) =32.45+20log10 (*d*) + 20log10 (*f*)

Where,

f: Frequency [MHz]

d: Distance between transmitter and receiver [m],Power is usually expressed in decibels (dBm).

2.2. *COST 231 Hata Model*

To predict the path loss in the frequency range 1500 MHz to 2000 MHz COST 231 Hata model is initiated as an extension of Hata model. It is used to calculate path loss in three different environments like urban, suburban and rural (flat). This model provides simple and easy ways to calculate range. The basic path loss equation for this COST-231 Hata Model can be expressed as:

PL=46.3+33.9log10(f)-13,82log10(hb)-ahm+(44.9-6.55log10(hb))log10d+cm

Where

d: Distance between transmitter and receiver antenna [km]

f: Frequency [MHz]

hb: Transmitter antenna height [m]

The parameter *cm* has different values for different environments like 0 dB for suburban and 3 dB for urban areas and the remaining parameter *ahm* is defined in urban areas as

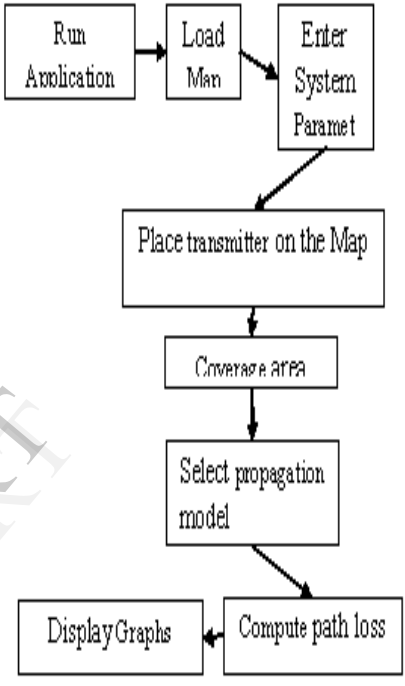
ahm= 3.20(log10 (11.75hr))^2-4.79

The value for *ahm* in suburban and rural (flat) areas is given as

ahm= (1.11log10f-0.7)hr-(1.5log10f-0.8)

3. Calculating path loss and connectivity coverage in wimax using propagation model

For wireless communication system, the system should have the ability to predict the accurateness of the radio propagation behaviour.



The site measurements are expensive and costly. Propagation models have been developed as low cost, convenient alternative. By using the wireless model and propagation loss details, we can try to cover the geographical area by simulation method. In this method, we use a geographical area images available on the internet or from the Google earth. For that test image enter the system parameters like Frequency [MHz] ,Transmitter Power [dBm]

,Transmitter Gain [dBi] ,Receiver Gain [dBi] ,System Loss [dB],Transmitter Height [m] ,Receiver Height [m] and Distance [km] . And select wimax transmitter on the map area. And after this coverage area is covered by using Cost 231 Hata model. By using propagation model calculation and observing coverage area we get result such as received power, coverage area, and propagation losses.

Conclusion:

WiMAX Technology is also one of the emerging wireless technologies that provide us high speed mobile data and telecommunication services. Estimation of path loss is very important in initial deployment of wireless network and cell planning. Since site measurements are costly, propagation models have been developed as suitable, low-cost, and convenient alternative. In this for WiMAX network we calculate the connectivity coverage and propagation path loss by using propagation model. Using propagation model we can calculate received power, propagation path loss and coverage area.

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