International Journal of Latest Research in Engineering and Technology (IJLRET)
ISSN: 2454-5031
www.ijlret.com‖ Volume 2 Issue 1‖ January 2016 ‖ PP 31-33

A Proposal On Path Loss Modelling In Millimeter Wave Band For Mobile Communications

N.S.Murtisarma
Sreenidhi Institute of Science and Technology
Yamnampet, Hyderabad-501301.

Abstract: A proposal for carrying out research work in mobile communications is outlined. A sample result on scintillation is discussed. The result found in agreement with the published plot.

Key words: cellular systems, path loss, millimeter waves, absorption, personel communications.

1. Introduction

In the present cellular systems, frequency bands in VHF range namely, 800 – 900 MHz are used. As the number of subscribers is growing day by day, the VHF band is unable to meet the demands. As a solution to this problem, 60GHz frequency band in the millimeter wave spectrum is proposed due to its large bandwidth and better propagation characteristics than that of visible and infrared spectra.

In the region between 10 and 100 GHz, there are two absorption regions; one is near 222GHz due to water vapor and the other near 60GHz due to oxygen. The atmospheric absorption depends on the operating g frequency with a peak loss at 60GHz of 15dB/km. The limited range caused by absorption can be turned into an advantage in a secure communication system. By using a minimum required range and a narrow band width, interference transmissions originating outside the links coverage can be avoided. For effective use of these frequency bands, influence of meteorological conditions has to assess accurately. The advantages of using the millimeter wave frequency band includes large bandwidth, increasing immunity both to friendly and hostile interference and it can provide secure communications.

For the estimation of propagation path loss for designing the cellular mobile communication system, Hata model is widely used. Maximum frequency of operation in model is 1500MHz. At present no model is available for millimeter wave applications. Hence in this work frequency scaling technique is used to investigate whether the Hata model can be extended to millimeter wave region.

A.Theoretical background

As per statistics only about one third of business telephones calls succeed in connecting the calling and called parties. A large portion of business calls failure because people spend much of their time away from their telephones. The fixed telephone network which provides connection to a place and not to a person is unable to meet needs of a dynamic person (Seth, 1993). To overcome this constraint, cordless telephony for residential users and mobile telephones for outdoor car mobile applications were developed. Personal Communication Network (PCN) will allow a subscriber to be on line irrespective whether he is in office, residence or in transit.

The Oxygen absorption was first studied by Van Vleck (1947). The Oxygen absorption which is of direct interest to the present discussion has absorption band at 60GHz. The Oxygen molecule (O_2a) which is paramagnetic has a permanent magnetic dipole moment. This is produced by the unpaired spins of two electrons. This angular spin momentum can be described by a spin quantum number S=1. The rotations of the oxygen molecule exclusive of spin can be described by the rotational quantum number. The magnetic moment interacts with the end over end rotations of the oxygen molecule. The two moments combine vectorially to form a total momentum vector described by the quantum number J which can take on the values J= [N-1, N, N+1].because the oxygen nucleus is devoid of spin the pauli exclusion principle permits N to assume only odd values but can vary from 1 to ∞. The energy levels J = N-1 and J=N+1 nearly coincide and differ from J=N by energy intervals which depend on N and produce resonance frequencies around 60 GHz and also at other frequencies like 119 GHz.

The attenuation by rain can be predicted accurately if the rain can be precisely described all the way along the path. Path attenuation is essentially an integral of all the individual increments of rain attenuation caused by drops encountered along the path. This is the physical approach to predicting rain attenuation. Unfortunately rain cannot be described accurately along the path without extensive meteorological data bases, which do not exist in most regions of the world. Most prediction models therefore resort to semi empirical approaches, which calculate an effective path length through the rain, L_{eff}, over which the rain fall rate is assumed to be constant. This constant rain fall rate leads to a constant specific attenuation, $y_{R,}$ and the path attenuation, A, is simply given by

A= $y_{R,}$ L_{eff} d B

Radio transmission in mobile communication systems often takes place over irregular terrain. The terrain profile may vary from a simple curved earth profile to a highly mountainous profile. The presence of trees, buildings and other obstacles are to be taken into account.

A number of propagation models are available to predict path loss over irregular terrain. Most of these models are based on a systematic interpretation of measured data obtained from service area. One of the more popular outdoor propagation models is the longy-Rice model. This model is also known as ITS irregular terrain model. This model is applicable to point-to point communications in the frequency range from 40 MHz to 100 GHz over different kinds of terrain. Okkumara model is one of the most widely used models for signle prediction in urban areas. This model is applicable for frequencies in the range of 150-2000 MHz and distances of 1-100 Km. the Hata (Hata, 1980) is an empirical formulation of the graphical path loss information provided by Okumara.

B. National and international status of the proposal.

The expressions for amplitude and phase spectral density functions for complete solution and asymptotic expansion method are obtained (siqueira etal.,1991).the millimeter waves in an urban area experiencing fading due to multi path reflections and scattering.(Violette etal.,1988,thmos etal.). for the estimation of propagation path loss for urban, suburban and rural areas, empirical formulae are available at VHF frequencies which are using for designing the present systems(Hata, 1980). Various probability distributions like Gaussian distribution, Log normal distribution, Raleigh distribution etc. in radio wave propagation were studied. Besides this, several other papers textbooks and various telemetric and electronics for you were referred.

2. Proposed Methodology

During the early 1980s, analog cellular telephone systems were experiencing rapid growth in Europe, particularly in Scandinavia and the United Kingdom, but also in France and Germany. Each country developed its own system, which was incompatible with everyone else's in equipment and operation. This was an undesirable situation, because not only was the mobile equipment limited to operation within national boundaries, which in a unified Europe were increasingly unimportant, but there was also a very limited market for each type of equipment, so economies of scale and the subsequent savings could not be realized.

An estimation of scintillation effects is to be studied. Attenuation due to oxygen absorption and propagation path loss for urban areas are to be studied. Asymptotic expansion method is used for estimating the spectral density functions. Variance is to be estimated from the spectral density curve. From this information, standard deveation is deduced. Fading level of scintillations is calculated from the standard deviation, which is to be added to the total propagation path loss for developing propagation model.

A.Work elements to realize the proposal

The work is being aimed at developing of path loss model for mobile communication systems. This is planned to achieve through the following tasks

1. The principles of working of various mobile systems will be understood.
2. Rain induced attenuation effects revelent to mobile communications will be surveyed.
3. Investigation of appropriate path loss model at millimeter wave frequencies.
4. The developed model will be validated experimentally.

3. Result and discussion.

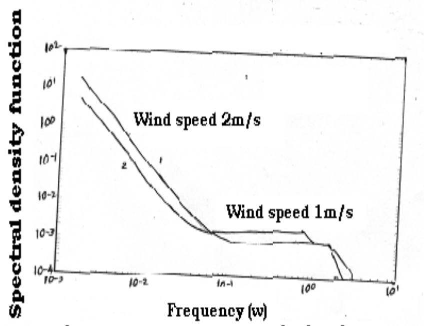

Figure1: Log-amplitude scintillation spectrum at 55GHz for a plane wave

Fig1 representing the comparison of log amplitude spectra at 55 GHz for plane wave for wind speeds 1.0 m/s and 2.0 m/s. The plots for the programs asdp55.m and asdpv2.m are super imposed for obtaining the figure.It is observed that the energy content in both the low frequency region and high frequency regions is more for higher wind speeds and left for lesser wind speeds in transition regions. Also noticed that corner frequencies increased with wind speed. Results obtain are matched well with the published results. The log amplitude and phase spectra at 55 GH_z , $57GH_z$ are almost the same which are indistinguishable due to a small change in wave number . in the high frequency the expression for the cross spectral density function for spherical wave case are twice those for the plane wave case In low- frequency region, phase spectrum for both spherical wave and plane waves are the same in low frequency region log amplitude auto spectra for spherical wave is approximately 10 dB lower than plane wave case . For theoretical scintillation spectra , numerical evolutions can not be extended to higher frequency components due to the divergent nature of the confluent hyper geometric function and Meijer's G function which make the evaluation routines numerically unstable A fading level of about 30dB is to be consider for urban environment due to multipath reflections for an operating frequency of 57GHz frequency-scaling techniques can be applied to Hata's model at 60 GH_z when frequency scaling techniques is applied, obstacles like trees, trucks, buildings etc. can not be scaled when fade margin is Considered; total path loss is nearly equal to the path loss with that of Hata model. Gaussian distribution is considered for estimation of scintillation effect on propagation path loss Amplitude scintillation is of the order of 1.6 dB peak to peak , observed a slight effect on the propagation path loss It is possible to conclude, a 57 GHz cellular system is ideal choice to meet the increasing demands of the sub scribers

4. Conclusions

A proposal to working in modeling area of mobile communications is outlined. A sample result that was in agreement with the published plot is also presented.

Acknowledgement

The drafted proposal is based on association of Sri J.V.Ram Mohan Rao, BSNL, Hyderabad. Thanks are due to his kind co-operation.

References

[1]. Ishimaru.A, "Temporal radio frequency spectrs of multifrequency waves in trubulent atmosphere", IEEE Trans. On Antennas and propagation, Vol AP20, pp. 10 -19, 1972.

[2]. Saleh Faruque, "Cellular mobile system engineering", Artech house, 1996.

[3]. Lee W.C.Y., "Millimeter wave link set up", Private communication, 1973.

[4]. Van Vleck J.H., "The absorption of microwaves by Oxygen", phyrev., vol 71, pp 413 – 424, April 1947.

[5]. Siqueria G.L., Cole R.S., "Temporal frequency spectra for plane and spherical wavesin a millimeter wave absorption band", Trans on Antenna and Propagation, Vol 39, No.2, pp 229 – 233, February 1991,

[6]. Violette E.J., Espeland R.H., De Bolt R.O., Schwering F., "Millimeter wave propagation at street level in urban environment", IEEE Trans. on Geoscience and remotesensing,vol.26,No.3,May 1988.

[7]. Hata M., "Emperical formula for propagation loss in land mobile radio services " IEEE Trans on Vehicular Technology, VT – 29, No.3, pp317-25. August 1980.

[8]. Harold Exton, " Handbook of Hypergeometric integrals", Ellis Horwood limited, Halsted press, 1978.