Journal of Theoretical and Applied Information Technology
10th December 2015. Vol.82. No.1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

COMPARATIVE ANALYSIS OF PATH LOSS ATTENUATION AT OUTDOOR FOR 1.8GHZ, 2.1GHZ IN URBAN ENVIRONMENT

N.V.K.RAMESH,[1] K. SARAT KUMAR, [2] D.VENKATA RATNAM, ,[3] DR. MD. ALI HUSSAIN [4] Y.V.SAI JASWANTH [5] P.SARAT CHAITANYA

Assoc.Professor, Department Of Ecm, [1]professor, [2] Professor Department Of Ece,[4]professor Department Of Ecm

[4,5] Student, Department Of Ecm, K L U (K L University), Vaddeswaram, Guntur Dt., A.P., India.

ABSTRACT

We investigated the radio signal path attenuation behavior by conducting a measurement survey in a GSM network, which is transmitting at 1.8GHz and 2.1GHz band in the Vijayawada city, Andhra Pradesh, India. Initially the measured field strength data collected at various locations from the base stations are used to estimate the path loss. It has been observed that the path loss increases with distance in this case. In this paper a detailed analysis for the calculation of path loss by using Okumura Hata model and the Cost 231 Hata model. We calculated the path loss data and compared with real time data obtained for both 1.8GHz and 2.1GHz in an urban environment by using the received signal strength (RSS) of the base station with and without noise. Our experimental result shows that the Okumura Hata model is one of the best models for calculation path loss at urban environment.

Keywords: *Path Loss, Coverage Area, Base Tran's Receiver Station (BTS), Mobile Station (MS) Global System For Mobile Communication (GSM)*

1. INTRODUCTION

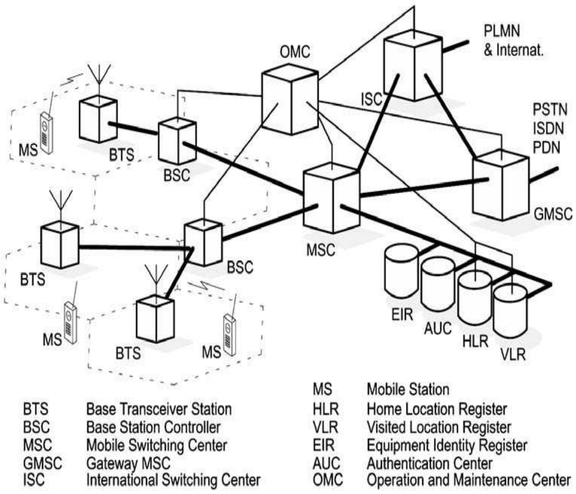
Mobile communication has appreciated one of Mobile communication has appreciated one of the multimedia applications.TheGSM stand for GSM Global System for Mobile communications[3] contains the essential intelligent functions for the support of personal mobility, smart function, especially with regard to the identification and authentication of users and is an ETSI standard for digital cellular 2G phone with international roaming [4]. The technology was used almost exclusively from GSM for voice communication but for short message services (SMS) soon became very popular among users of GSM. The GSM and its enhancements (including UMTS air interface) will remain the technological base for mobile communications for many years and will continue to open up new application areas.[8]

The GSM system is composed of three main segments like mobile station (MS), the system of the sub base station (BSS) and the network switch station (NSS). A GSM digitizes and compresses data are then send it through a channel with two other streams of data and use each in its own time slot at 1.8 GHz, 2.1 GHz GSM chose any one of TDMA / FDMA. The GMSK is adopted by GSM [5]. GSM is a cellular network. There are five different cell sizes in a GSM they are macro, micro, Pico, Femoto cells and Umbrella network. The coverage area of each cell varies depending on the application environment [3]. **Macro cells** cover metropolitan areas in the order of several kilometers in the location of the base stations and building above average roof level to 40m etc. **Micro Cell** specification covers the inside of antennas mounted at the street height on the lower heights these are commonly used in urban areas. **Pico Cells** are small cells within building those are used by supporting local networks whose coverage area is in few tens meters. **Femoto Cells** are the smallest cells designed for

Journal of Theoretical and Applied Information Technology
10th December 2015. Vol.82. No.1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

using in residential or smaller areas. These are generally used for laptops, notebooks and connect to the service provider's network through a wireless broadband Internet environment.



An Umbrella cells are used to cover uncovered (shadowed) regions of smaller cells and fill in gaps these coverage between the smaller cells [6]. Level data signal strength downlink was collected using GSM mobile test and analyzed using research. The power - to - antenna transmission was for both 2.1GHz and 1.8GHz is 14W.Both the base station sectors are facing in the same direction that has a gain of 14dB,In this paper we proposed the method the best method for calculating the Path Loss. We proposed this model is due to the effect of path loss which decreases the signal strength in the transmission. The technique which we used in this paper has been discussed about the insufficient drive testing that may be affect the offset this problem is also known as effective fade margin[8].we have collected the GSM data from the BSNL office for the both 1.8 and 2.1 GHZ frenquecy's.the data we collected is about the 3-4 kms.we collected the transmitted data and the received data at the base stations. We considered the collected data from the BSNL is Path Loss Practical data and we calculated the Path Loss by using the distance by using the formula. For calculating the Path Loss terrifically value's we used the two models there are Cost-231 and Okumura model's we considered these for comparing the experimental data in real time.

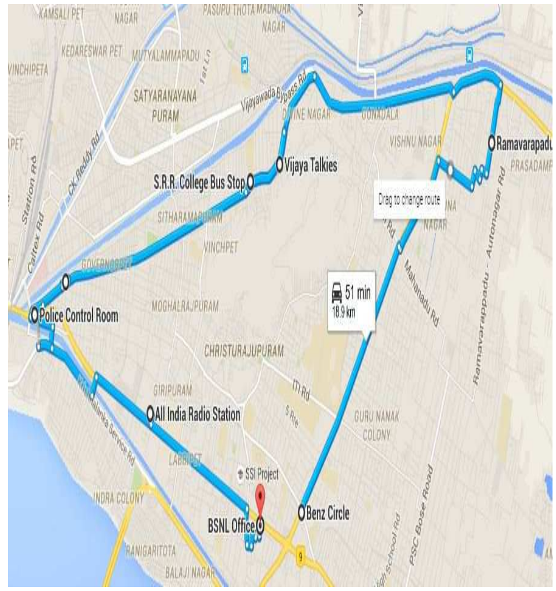


Figure 1. Test Drive At Vijayawada

2. PATH LOSS MODELS

Path loss is the reduction in power density of an electromagnetic wave as it propagates through space. Path loss is the major component in the analysis and design of the link budget of telecommunication systems. Path loss commonly used in both wireless and signal communications.

The following factors like free space loss, Refraction, Diffraction, Reflection, Aperture will affect the path loss

The following are the three types of models to calculate the path loss:

1. Empirical models
2. Semi-deterministic models
3. Deterministic models

Empirical model: Empirical models are usually a set of equations derived from extensive field measurements and empirical models are simple and efficient to use [10] the measurements were made With these models are Very accurate for environments with the same characteristics The input parameters for the empirical models are usually qualitative and not very specific like

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

urban area and suburban area. Based on our paper we refer to the empirical models like Hata model,cost-231 model

2.1 COST -231 Hata Model

The Cost-231 model is used widely for calculating the wireless mobile system's [7]. This model is used only in particular band width from 500 MHZ to 2.1GHZ (2000MHZ) because this is frequencies of the mobile. The bellow given equation gives the Path Loss in dB's[3.10] and the equation is

$K = 46.3 + 33.9 \log_{10}(f) - 13.821 \log_{10}(hb) - X(hm) + (44.9 - 6.55 \log_{10}(hb)\ \log_{10}(d) + cm$ ---------(1)

Where $X(HM) = 3.20 (\log_{10} (11.75hour))$ 2-4.97 for f> 400MHz------- (2)

Where f = frequency in MHz, d = distance between AP and CPE antennas in km, hub is the AP (point scale) antenna height above ground level in meters.

$ncost = (44.9 - 6.55 \log 10(hb)/10$ -- (3)

The cm value in the above equation will be 0(zero) for the smaller cities and the cm value will be 3 dB for larger cities. Here smaller means sub-urban areas and the larger means urban areas. When he is the CPE (Customer Premises Equipment) antenna height above the ground. Observation of (7) to (9) reveals that the path loss exponent of the predictions made by the COST-231 Hata model. To evaluate the applicability of the model for the COST-231 2.1 GHz band, the model predictions are based on the measurements from three different environments namely urban ,sub urban and the rural.but,as per our paper we considered only the urban environment only.

Coverage: VALIDITY RANGE OF THIS MODEL

Frequency range is between the 150-2000 MHZ

Mobile Station antenna height lies between the 1-10 m

Base Station antenna height lies between the 30-200 m

Link distance also lies between the 1-20 Km

Okumura Hata Model

The Okumura Hata model is one of the empirical model which is used to calculate the Path Loss. This model is used to calculate the Path Loss from the 150MHZ to 1500MHZ.this model is also used to identify the height of the antennas of base station and the mobile these two are the important factors to calculate the Path Loss. Masahuru Hata created empirical models that provide good fit to the measurement taken by Okumura for the transmitter receiver separation is d is more than 1Km and the expression for path loss is developed by Hata is called Okumura –Hata is shown by equation (4) Hata presented the urban area propagation laws as a standard formula's and supplied correction equations for applications to other Situations.[8]

Hata model is based on Okumura's field test results and it predicts various equations for path loss with different types of clutters [7]. The Limitations of the Hata Model test results include its frequency's (150 MHz to 1.8 GHz),the distance from BTS (50m to 20Km), and the height of base station antenna (30m to 200m) and the height of mobile antenna (1m to 10m). Mathematically, the Hata model path loss is expressed for different environments such as the urban, suburban and open area. Hata model produces good results for the hilly rural terrains because the geographic details of this environment are not specified.

Path loss for urban, suburban and rural clutters is expressed as

$$lP(Urban) = 69.55 + 26.16\log(f) - 13.82\log(hb) - a(hm) + (44.9 - 6.55\log(hb))\log d \text{ --(4)}$$

$$lp(suburbman) = lp(urban) - 2\{\log(f/280\} \text{ -- (5)}$$

Where a(hm) is a correction factor for the mobile antenna height based on the size of the coverage area. For small to medium sized cities, this factor is given by:

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

a(hm)=(1.1log(f)-0.7)hm-(1.56log(f))-0.8 ----(6)

The a (hm) value for the larger cities. the frequency will be nearly or greater than 1.8GHZ,
a(hm)=12.78hm-19.918 dB ----(7)

The a(hm) value for the frequency will be nearly or greater than 2.1GHZ,
a(hm)=12.854hm-20.02 dB -----(8)

Although Hata's model does not have any one of the path specific corrections which are available in Okumura model the Predictions of the Hata Model Compare very closely with the original Okumura Model.

Coverage: VALIDITY RANGE OF THIS MODEL
Frequency range lies between150-1920 MHZ
Mobile Station antenna height lies between 1-10 m
Base Station antenna height lies between 30-1000 m
Link distance lies between 1-100 Km
T_X------R_X distance are between 1m------10Km

3. BSNL data:

The Table 3 shows the comparison between two mobiles in the same area and receive the information from different base stations.In this the Rx level in a dedicated network for GSM RP(MS1) and MS2 in full mode is more than a sub .Here RXquality in full mode is also more than sub mode. And the BERactual is 1.80 where as MS2 is 0.The MS power for MS1 is less than MS2
Table 4.

Table 1 . BSNL data

Receiver(BTS)	*Value*
Latitude	*16.478182*
Longitude	*80.64899*
Cable loss	*1.3*
Interference margin	*2dB*
Fading margin	*5dB*
D.C power	*20dbm*

4. ENVIRONMENTAL DESCRIPTION

The Figure 2 shows the path loss calculations for two different models like HATA and COST-231 model [7]. The Figure 3 shows the comparison between distance verses Rx signal strength for GSM and 2G The measurement was conducted radially from the transmitter in urban areas and the route started BSNL office M. G. Road and ending at the RTC bus stand. In this case the measurements were take up to 12 Km from the transmitter. The first 3 Km is densely populated with multistoried buildings like three storied and four storied buildings and road width is 100 feet denoting urban conditions and a few tall trees are located near the Road and beyond the 4Km a big junction called as ramavarapaddu junction[2] .During the time of measurements nearby road is filled with heavy traffic. In connection beyond the 4Km there is big hill is located which we called as Gunadala konda.the scattering and diffraction of the signal leads to pathloss.Typically 40% of the area is filled with houses and concrete buildings and after 5 to 12 Km more number of shopping complexes and the measurements ended at Radio station. Our reference point Currency nagar It lies within latitude80.67486 and longitude 16.51675 .it is situated nearly 4 km by road

The Figure 2 shows the comparison between the path loss for different models of Gsm like HATA,COST-231 at 1.8GHZ and 2.1GGZ.The Theoretical value of the cost-231 is more appropriate to calculate the path loss for the urban environment. The path loss calculation using HATA-OKUMURE and COST-231 shows that,We observed that the COST-231 model has a greater path loss therefore the HATA-OKUMURE is better than the COST-231 model for the both 1.8 and 2.1 GHZ frequency's in the urban environment.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

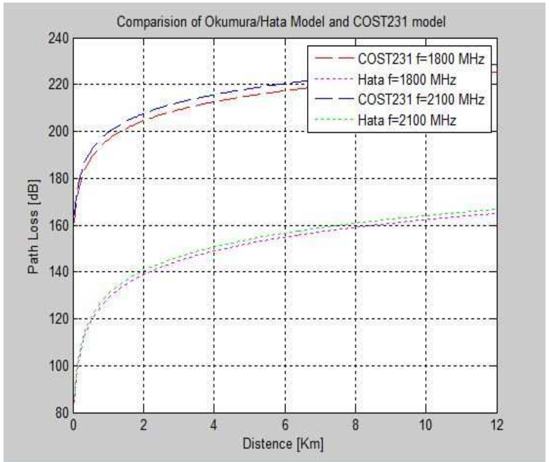


Figure 2. Path Loss Calculation

5. RESULT

In this paper We presented the Path loss models are investigated with real time GSM cellular system at BSNL Vijayawada The environment such as urban area of Vijayawada were chosen through BTS specifications of such environment using two propagation model such as Okumura model and COST-23 model. The real time, signal strength value is compared with the received signal strength value is calculated using HATA and COST-231 models. The table 2,3and 4 shows the different real time data is obtained from test drive by using TEMS(Test mobile system measurement unit) is a special software used for processing and analyzing the collected measurement and display the measurements on the maps and the table 5 shows the data is collected from to test mobile MS1andMS2 at Currency Nagar in Vijayawada. The path loss is more appropriate to calculate the RX level, and path loss in GSM cellular communications at BSNL-Vijayawada. The Figure1 shows the comparison between the real time values and the predicted RSS values by HATA, COST-231 Hata Model, and models in urban environment which is taken from BSNL OFFICE (MG road) to Eluru road on longer and the distance (200,400,600.....) according to propagated model is also longer in wireless communication.

For calculating the path loss in the urban areas at any distence for 1.8GHZ and 2.1 GHZ is:
Lp=376.871+(35.224)log D
Lp=378.651+(35.224)log D

Table 2 Data Collected From BSNL Vijayawada

Parameter	**ServRx QualSub dB**	**Serve RxLevSub dB**	**Distance mts**
Mean	1.645854191	-68.51114954	6775.492877
Mode	0	-67	9641.514648
Median	0	-68	7818.80957
Maximum	7	-43	9641.514648
Minimum	0	-94	0
Count	10987	10987	5505
S.D	2.335261587	7.646910025	3106.95523
Variance	5.453446679	58.47523293	9653170.803

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Table 3 Data Collected From Different Mobiles At Vijayawada

Distance in Km	Towards	Hata (dB)	Cost231 (dB)
.1Km	M&M showroom	301.05	335
.5Km	Benz circle	347.4	382.1
1Km	Stella college	347.4	409.3
1.5Km	Ramesh hospital	393.74	428.5
2Km	Medical college	408.66	443.7045
2.5Km	Aruna residency	420.85	455.64
3Km	Veterinary colony	431.15	465.9
3.5Km	Currency nagar	440.08 8	474.88
4Km	Gunadala	447.9	482.7
5Km	S.R.R.College	495	489
6km	Sitarampuram	461.3	496.1
7Km	Vijayatakis	467	501
9Km	Challapallibangala	472.5	507
10Km	Bus stand	477.5	512.2
12Km	Radio station	482.11	516

Table 4.Practical Path Loss Calculation

GSM-CC MS1,MS2,	GSM RP(MS1)dB Full Sub		GSM RP(MS2) dB Full Sub	
Mode	Dedicated	Ideal	Dedicated	Ideal
RX Level	-68	-67	-67	-66
RX quality	2.26	.14	.14	.14
FER	0	0	0	0
BER actual	1.80	--	0	0
FER actual	0	0	0	0
C/I Worst	17.2	30.3	22.3	22.3
MS power	5	---	---	12
RL time out	64	---	---	64
SQI MOS	0	0	3.80	

From the above table we conclude that as distance increases path loss will also increases.but when compared to the above models the hata model is better than the cost-231 model so it is prefor to use the hata model in the city's while calculating the path loss.

We observed from the above table the path loss of hata model at currency nagar (440 dB) is lower than the cost-231 model (474 dB).we also observed that as distance increases the path loss also increases.in the same way the path loss is changed at aruna residency and veterinary colony.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Table 5.Path Loss At Particular Locations

Site name	Longitude	Latitude	Orientation	Tower ht	Building height	ANTENNA HT	MECHANICAL Tilt	Electrical Tilt	BCCH	Basic
CURRENCY NAGAR	80.67486	16.51675	60/170/280	12M RTT	10M	22M	0/0/2	1/4/4	69/66/71	27/42/25
ARUNARESIDENCY	80.66164	16.50242	30/110/240	15M RTT	15M	30M	4/4/2	0/0/0	68/66/74	40/20/30
VETERNARYCOLONY	80.66581	16.51184	10/180/290	30M GBT	0M	24M	3/1/0	4/2/4	78/74/76	30/32/41

6. CONCLUSION

This research work has shown the outdoor path loss model for urban area. The path loss of Okumura and cost 231 models shows increasing value with respect to transmission distance and path loss decreases as the height of the transmitting and receiving antennas. The comparisons between the models as we discussed above the practical value and the theoretical value is more for the cost 231 model.so, we prefer the okumura's Hata model when compared based on the path loss in Urban areas. These variations show that the Okumura Hata model is best for these type of environments. Remaining models does not fit to this environment.to make such models appropriate for different environments, they must be corrected. This can only be done by carrying out field measurements in the environment. The measured data is then used to correct an existing model or to develop a new model for the environment.

7. ACKNOWLEDGEMENT

The Authors express their thanks to the Department of ECM and the management of K.L.University for their continuous support and cooperation during this work. We are extending our profound sense of respect and gratitude to P.Ramachandrarao, and M.S.Sridhar BSNL, Vijayawada under whose precise guidance and gracious encouragement we had the privilege to work.

REFERNCES

[1] "Path lossprediction for GSM mobile networks for urban region of ABA,South-East Nigeria" *International Journal of computer science and mobile computing,vol.3 Issue.2,February-2014,pg.267-281*

[2] " A study on path loss analysis for GSM mobile networks for urban,rural and suburban regions of Karnataka State" *International journal of distributed and parallel Systems(ijdps) Vol.4,No.1,January 2013*

[3] "Received Signal Strength (RSS) Calculation for GSM Cellular System" at BSNL Pondicherry using Modified HATA Model P.Saveeda, E.Vinothini, Vardhi Swathi and K. Ayyappan. *International Journal of* State, Nigeria Shalangwa D. A.1, Waba, S. A1, Jerome G.2 & Danasabe A.1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

[4] Performance analysis of propagation model for predicting RSS for efficient hand off international journal of advanced scientific and technical research issue2, volume1(February 2012)ISSN:2249-9954

[5] "Monitoring and Evaluation of Global System for Mobile Communication (GSM) Signal Strength at 900MHz in Sub Urban Area" Shalangwa D. A. and Singh.

[6] "Comparative study of path loss models depends on various parameters" S.Purnima Sharma Research scholar, UTU, Dehradun (India).

[7] "Comparative Study of Path Loss Models in Different Environments" Manju Kumari Tilotma Yadav2, Pooja Yadav3 Final Year (ECE), DAVCET, Kanina (INDIA), Purnima K Sharma4, Dinesh Sharma5.

[8]T.S.Rappaport, "Wireless communications", 2nd Edition, Prentice Hall,(Chapter 4, 2002**1)** Received Signal Strength (RSS) Calculation for GSM Cellular System at BSNL Pondicherry using Modified HATA Model P. Saveeda, E. Vinothini, Vardhi Swathi and K.Ayyappan.

[9] "Principles of wireless network" by Kaveh pahlavan, Prashant Krishnamurthy Volume.

[10] Propagation Prediction Models for Wireless Communication Systems Magdy F. Iskander, Fellow, IEEE, and Zhengqing Yun, Member, IEEE IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES, VOL. 50, NO. 3, MARCH 2002