Parameter Analysis of Semi Deterministic Pathloss against Soft Handover Performance in Mobile Communication

Maksum Pinem[1], Muhammad Zulfin[1], Indah Vusvita Sari[1], Sri Indah Rezkika[1]
[1]Electrical Engineering Department, Universitas Sumatera Utara, Padang Bulan, 20155 Medan, Indonesia

Keywords: Radio Propagation Models, Propagation Parameters, Mobile Communication Performances, Simulation Programming.

Abstract : This research focused on assessment of the parameters semi-deterministic propagation model in effort enhancement performance soft handover in mobile communication, so obtained characteristic model propagation parameters affecting relations with enhancement performance soft handover. The method used is design simulation with computer programming by building a model of virtual mobile communication system with software. The propagation model and handover model that has been applied in this research are Cost231 Walfisch-Ikegami and soft handover-hysteresis with threshold. The observed parameters were height of building, street width and distance between buildings. While the performance parameters system wireless moves are observed, ie : drop call rate, radio link increase rate and active set average rate. From the simulation result obtained, ie : the increase in height of the building causes decreased radio links, increased drop call rates and reduction of the average number of active sets. Whereas on the contrary with the width increase between buildings and street width respectively causing the increase of radio link, decrease of drop call rate and addition of active set average amount.

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1 INTRODUCTION

The Path loss is the electromagnetic wave that spreads through the space between the transmitter antenna and the receiver antenna in the communication system. It can be caused on decline quality and the strength of radio signals due to the effects of reflection, refraction, diffraction, scattering and absorption. The effect are influenced by environmental conditions, frequency of operation, distance between transmitter and receiver (O.O. Oni and F.E. Idachaba, 2017). Although thus, high mobility of user movement in mobile communication are caused by the strong fluctuations of the received signal level as a result of propagation damping, distance and obstacles the environment is not irregular (Maksum Pinem, 2014). To maintain the stability and continuity of mobile communication, a service switching mechanism called handover is required .

For the new generation network move needed an innovative predictive model related with frequency . On research previous has analyzed six predictions model of loss different paths and as a whole is the best choice for a new generation of networks moving regardless of distance and type of environment (Aymen Zreikat and Milan Dordevic, 2017).

Caused of high mobility of the MS moving from one cell to another cause difficulty in backing prediction signal propagation and effect on signal strength level of reception. Strong level signals received by MS is influenced by path loss, shadow fading and fast fading, as a result of the propagation and attenuation of irregular circumstances (Singh, N. P and Singh.B, 2010).

Study on signal radio spreading is very important in the wireless network within effort keep quality signal communication and stability continuity communication move between user (handover), beside magnitude funds to prepare infrastructure from communication system wireless. By therefore, this study are focused on assessment of the parameters of the semi-deterministic path loss propagation model in effort to enhancement performance soft handover in mobile communication, so obtained characteristic

Pinem, M., Zulfin, M., Sari, I. and Rezkika, S.
Parameter Analysis of Semi Deterministic Pathloss against Soft Handover Performance in Mobile Communication.
DOI: 10.5220/0010080502430247
In *Proceedings of the International Conference of Science, Technology, Engineering, Environmental and Ramification Researches (ICOSTEERR 2018) - Research in Industry 4.0*, pages 243-247
ISBN: 978-989-758-449-7
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model propagation parameters affecting relations with enhancement performance soft handover, so expected this research give contribution on guarding quality signal communication and stability continuity communication.

2 MODEL DESIGN

In this study, the modeled BS consists of two base stations. Each BS has the same and separate transmit power at distance D and mobile station (MS) moves on a straight path with a regulated speed as shown in Figure 1 (M. Pinem and R. Fauzi, 2018). As the mobile station moves, the signal is obtained mobile station has decreased. This decrease caused of the distance accreation and obstacle around the base station to the mobile station. Large signal decrement in this study is modeled by propagation model Cost 231 Walfisch-Ikegami.

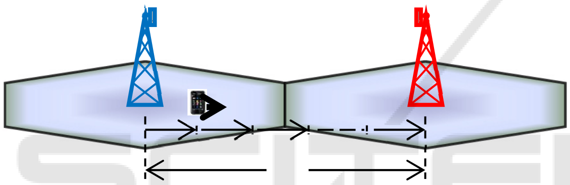

Figure 1: Network model

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Received signal strength by mobile station initiated for soft handover algorithm. Performance of soft handover consisting of drop call rate, radio link increase rate, active set average size and handover rate. Then, soft handover performance will be observed to the change of radio wave propagation parameter, ie : building height, street width, and distance between building.

Walfisch Ikegami COST231 restricted to :

a. Frequency (f_c) : 800MHz-2000MHz
b. High antenna BS (h_b) : 4 m - 50 m
c. High MS (h_m) : 1 m - 3 m
d. Distance BS and MS (d) : 0.02 km - 5 km.

The COST231 WI model is a suitable model used for predict unfortunate- loss trajectory in the area city. This model applied for area where transmitter no visible on directly by receiver caused the number object barrier in between transmitter and receiver as seen on Figure 2 (Maksum Pinem, 2018).

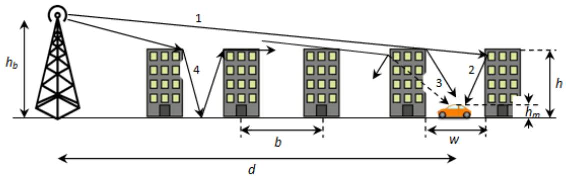

Figure 2: Illustration COST231 models Walfisch -Ikegami

There are four factors that are included in calculation of path loss for this model , ie (COST Action 231, 1999) :

a. High building (h)
b. Wide street (w)
c. Distance between building (b)
d. Orientation related street with LOS path (φ) .

This model distinguish between propagation of LOS and non-LOS. For propagation of LOS, this model use Equation 1 .

$$L_{LOS} = 42{,}6 + 26\log(d) + 20\log(f_c) \quad \text{for } d \geq 20 \text{ meter} \qquad (1)$$

For non-LOS propagation , this model use Equation 2.

$$L_{LOS} = 42{,}6 + 26\log(d) + 20\log(f_c) \qquad (2)$$

where L FSPL is loss room free (free space loss), L rts is losses resulting by diffraction " rooftop to street " and L msd is loss estimated effect existence influence diffraction from the number object barrier between base station and The nearest building with mobile station.

The Walfisch-Ikegami COST231 model has be accepted by body standardization international ITU-R and could applied for high antenna BS above rooftop . Mean error allowed is of ± 3 dB and standard deviation of 4 - 8 dB (Nining Triana, 2015).

3 METHOD

Implementation of this research is done with literature study, propagation parameter verification Cost231 Walfisch-Ikegami, designing signal transition generating virtual base station, system model design virtual communication, Application of soft handoff algorithm hysteresis threshold for two base station, determining simulation parameter input data, design of simulation coding (programming) on overall, testing the simulation by varying the observed variables from radio wave propagation model and analyze the simulation result. The block diagram of the system shown at Figure 3.

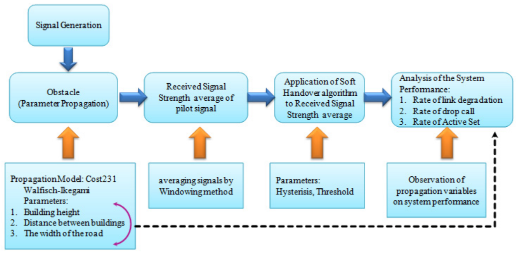

Figure 3: Design of System Model

The parameters used in the simulation are shown on Table 1. The program simulation in this study uses MATLAB software and data of research results obtained based on the data results of running simulation program that runs repeatedly. Furthermore, the analysis is done by statistical methods to see the relationship between input parameters with system performance parameters using Microsoft Excel.

Table 1: Simulation Parameters

Symbol	Description	Value
D	Side distance between BS	2000 meters
P_i	Transmission Power	23 dBm
BS	Base Transceiver Station	2 Unit
d_s	Sample point interval distance	1 meter
S_{min}	Minimum signal level	-90dBm
f	Frequency	900 MHz
σ	Standard Deviation	8 dB
Hys	Hysteresis	10 dBm
M	Window average length	20 signals
h	Building height	Variable
w	Street width	Variable
b	Distance between building	Variable

Performance analyzed in this study is based on building height, street width, distance between building and orientation streets that affect performance drop cal rate, radio link increase rate, active set avarage rate and handover rate.

3.1 Effect of Building Height on Soft Handover Performance

The relationship between the height increase of the building on the rate of decreasing the radio link, the Drop Call rate and the average of the active size is presented in Table 2.

Table 2: Influence of Building Height on Soft Handover Performance

Building Height (meter)	Drop Call Rate (prob.)	Link Degradation Rate (prob.)	Active Set Size average (unit)
20	0	0.0127	1.218
21	0	0.0127	1.219
22	0	0.0161	1.216
23	0	0.0195	1.218
24	0	0.0235	1.218
25	0	0.0287	1.213
26	0	0.0353	1.187
27	0	0.0428	1.138
28	0	0.0509	1.085
29	0.0014	0.0635	1.034
30	0.0272	0.078	0.975

It can be observed that with the increasing height of the building the decrease of Radio Link is higher, since the height of the building blocks the signal from BS, as shown at Figure 4. This will impact the weakening of the signal received by MS. So when the height of the building is at 29 meters then began to occur drop call. Drop call more frequent when the height of the building is set 30 meters. Conversely, when viewed from the parameter set active, the increase in the height of the building impact on the reduction of the number of active sets that serve the MS.

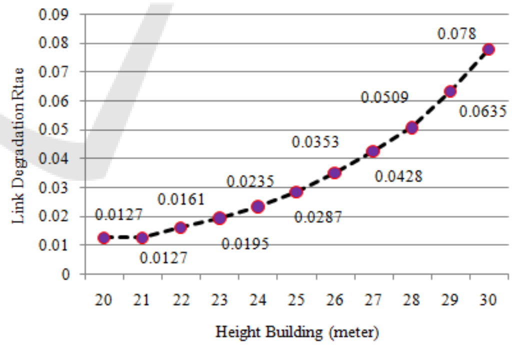

Figure 4: Link Degradation Rate

3.2 Effect of Street Width on Soft Handover Performance

The relationship between the increase of the street width against of the radio link degradation rate, the Drop Call rate and the average of the active size are presented in Table 3.

Table 3: Effect of Street Width on Soft Handover Performance

Street Width (meter)	Drop Call Rate (prob.)	Link Degradation Rate (prob.)	Active Set Size average (unit)
14	0.0045	0.0814	1.016
15	0.0023	0.0754	1.029
16	0.0012	0.0722	1.039
17	0.0006	0.0689	1.049
18	0.0001	0.067	1.060
19	0.0001	0.0647	1.069
20	0	0.062	1.077

It can be observed that with increasing street width the decrease of Radio Link is lower, meaning the signal is better because the increase of street width gives an increase spaciousness and flexibility of propagation of BS signal emission. This certainly reduces the signal attenuation that reaches and received in MS. So when the width of the street is set at 20 meters then the radio link is in the best condition, where at this distance there is no drop call at all, as shown at Figure 5. Therefore, when viewed from the active set parameter, the increase in the width of the street has an impact on increasing the number of active sets that serve the MS.

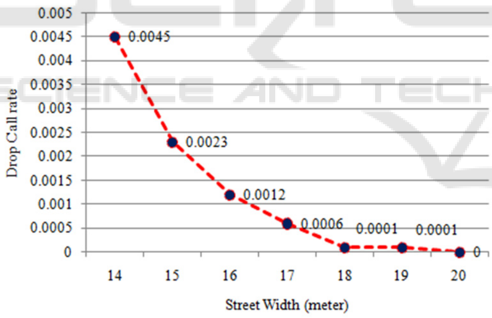

Figure 5: Drop Call Rate

3.3 Effect of Distance between Building on Soft Handover Performance

The next observation is the relationship between the increase of distance between buildings on the rate of decrease of radio link, Drop Call rate and the average of active size shown in Table 4.

Table 4: Effect of Distance between Building on Soft Handover Performance

Building Distance (meter)	Drop Call Rate (prob.)	Link Degradation Rate (prob.)	Active Set Size average (unit)
6	0.0048	0.081	1.018
8	0	0.0562	1.120
10	0	0.0394	1.197
12	0	0.0291	1.217
14	0	0.0221	1.218
16	0	0.0174	1.218
18	0	0.0138	1.218
20	0	0.0111	1.218

It can be observed that with increasing width of the distance between buildings, decrease of Radio Link is also lower. This means that the increase in signal strength is better because of the reduced signal barrier so that the increased freedom of propagation of the BS signal emission. This of course also affects the reduction of attenuation signals that reach and receive in MS. So when the distance between buildings set to 8 to 20 meters then the radio link is in the best condition of all, where there is no drop call at all. Likewise, when observed from active set parameters, the increase of distance between buildings also has an effect on increasing the average number of active sets serving MS toward servant stability, as shown at Figure 6.

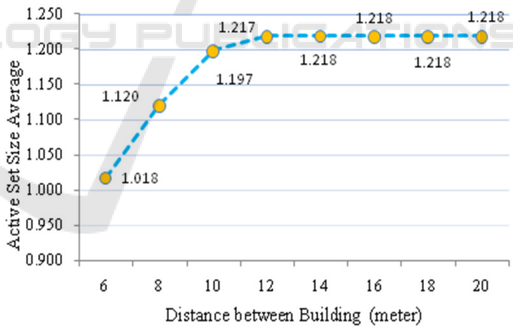

Figure 6: Active Set Size Average

4 CONCLUSIONS

This study has successfully demonstrated the relationship between semi-deterministic propagation model parameters and the performance parameters of soft handover in mobile communications. From the simulation results obtained that the increase in height of the building causes decreased radio links, increased drop call rates and reduction of the average number of active sets. Whereas on the contrary with the width increase between buildings and street width respectively causing the increase of radio link, decrease of drop call rate and addition of active set average amount.

ACKNOWLEDGMENT

This research was funded by Research Institute University of North Sumatera under TALENTA grant for Research Contract of Fiscal Year 2018.

REFERENCES

Aymen Zreikat and Milan Dordevic. (2017). Performance Analysis of Path loss Prediction Models in Wireless Mobile Networks in Different Propagation Environments. Proceedings of the 3rd World Congress on Electrical Engineering and Computer Systems and Science (EECSS'17) Rome.

COST Action 231. (1999). Digital Mobile Radio Towards Future Generation Systems – Final Report. European Communities, Luxembourg.

M. Pinem and R. Fauzi. (2018). The effect of various parameters of large scale radio propagation models on improving performance mobile communications. IOP Conf. Ser. Mater. Sci. Eng., vol.309, no. 135, p. IOP Publishing.

Maksum Pinem. (2014). Optimization of Performance parameter of CDMA System by Using Empirical Radio Wave Propagation Channel. Disertation, University of North Sumatera.

Maksum Pinem, et al. (2018). Characterization of Outdoor to Indoor Propagation in Urban Area by Using A Combination of COST231 Walfisch-Ikegami and COST231 Multiwall Models in 1800 Mhz and 2100 Mhz. International Journal of Engineering & Technologi (IJET), Vol 7, No 3.2, pp.: 698-702.

Nining Triana. (2015). Analysis of Semi-Deterministic Path Loss Propagation Model For Triple Band Applications in Metropolitan Area. Singuda Ensikom Journal Department of Electrical Engineering. University of North Sumatera.

O.O. Oni and F.E. Idachaba. (2017). Review of Selected Wireless System Path loss Prediction Models and its Adaptation to Indoor Propagation Environments. Proceedings of the International Multi Conference of Engineers and Computer Scientists, Vol II. Hongkong Another reference.

Singh, N. P and Singh, B. (2010). Performance Enhancement of Cellular Network Using Adaptive Soft Handover Algorithm. Wireless Personal Communications.