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POSSIBLE SOLUTION FOR TRAFFIC IN ROAMING SYSTEM

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Abstract: *Day to day the area of communication is growing up dramatically by the help of modern technology such as Mobile Communication is one of them. Moreover, Wireless Communication is one of the most powerful communication sector who makes the world small and globally because roaming system and handoff process both system has able to work together. As a result, it is not a problem for a cell user to get communication link from anyplace and any time. Again, in many situation handoff failures and unnecessary handoff are triggered causing degradation of quality of service. Moreover, data traffic created by several reasons but, commonly it happens from unnecessary handoff call by hard handoff technique that makes the system busy. Therefore, Global System for Mobile Communication (GSM) has effected by "Ping-Pong" problem. So, it is need to take more attention for remove that problem from the mobile network. However, in the environment of macro cellular system, one of the most popular models for signal strength prediction is Hata-Okumura model, and by that model this paper has calculated the strength of received signal with respect to the distance, and the result has adopted to reduce the several number of handoff call.*

Keywords: *Global System for Mobile Communication (GSM), Code Division Multiple Access (CDMA), Bit Error Rate (BER), Mobile Station (MS), Identification Interface Module (SIM), Base Station Controller (BSC), Mobile Switching Centre (MSC), International Mobile Subscriber Identity (IMSI), Visitors Location Register (VLR).*

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1. INTRODUCTION

Handoff is one of the most important processes for the Mobile Network area because; this is the root mechanisms for roaming system. When the handoff has done from one cell area to another cell area with two different boundary cells, and if they are under the same or dissimilar technology then this is known as Inter or Intra roaming system. Again, if the handoff has done from one satellite to another satellite or gateway to gateway by satellite between two different gateways then this is known as International roaming system, such as, if the visitor visit outside from his own country network then he will connect by global roaming system.

Moreover, there are have several handoff processes, but from the view of technological point, they are commonly used by hard Handoff and soft handoff. It has found that, the first and second generation of mobile communication has maintained by hard handoff process like, Global System for Mobile Communication (GSM) technology, and soft handoff, has first established with the cellular communication system of third generation, and this one has supported by the technology of Code Division Multiple Access (CDMA). Through hard handoff is less complex than the soft handoff, it has effected by 'Ping-Pong' effect. Therefore, GSM has suffered by 'Ping-Pong' problem. As a result, unnecessary handoff makes their system busy, so, the national roaming system has effected by traffic.

However, it is possible to increase the connection reliability by a path loss model. Therefore, the idle propagation model can play an important role for reduce the unnecessary number of handoff. This analysis paper will analyse by Hata-Okumura propagation model for remove the 'Ping-Pong' effect from hard handoff technology.

2. LITERATURE REVIEW AND BACKGROUND CONCEPT

2.1 Wireless Communications

Wireless Communication is one of the core communication techniques for technology field who carry the data from one cell to another cell without using the wires [1]. A Distance between sender and receiver involved either short like, a few meter long from television to remote control or a long distance such as, thousands of meters or thousands of kilometres for radio communications. From the technological science, it is also told that, wireless communication is one of the main foundations for mobile communication.

However, in 1864, the whole scientist meet with the equations of Maxwell's and before this equation, James Clark Maxwell had described the concept of electricity and magnetism. Moreover, after published that equation, a German physicist Heinrich Rudolf Hertz who have confirmed Maxwell's work in the science laboratory [2] and have proved that the radio wave's properties were reliable with the electromagnetic theory of Maxwell by designed a transmitter and receiver radio waves over several meters. In this way, the era of wireless started and in 1958 Germany have used the first network was the analogue A-Netz by using 160 MHz of carrier frequency. There have possible only for connection setup with the cell station but not with the handover. Advanced Mobile Phone System (AMPS) has published in 1983 which is an analogue mobile phone system and its usable carrier frequency at 850 MHz Until 1984 digital system have no available but that the German C-Netz used 450 MHz of carrier frequency when they transmitted analogue voice. Moreover, handover technique between old cells to new cell was now possible by AMPS system [3]. From 2000s, this analogue network has switched off [4].

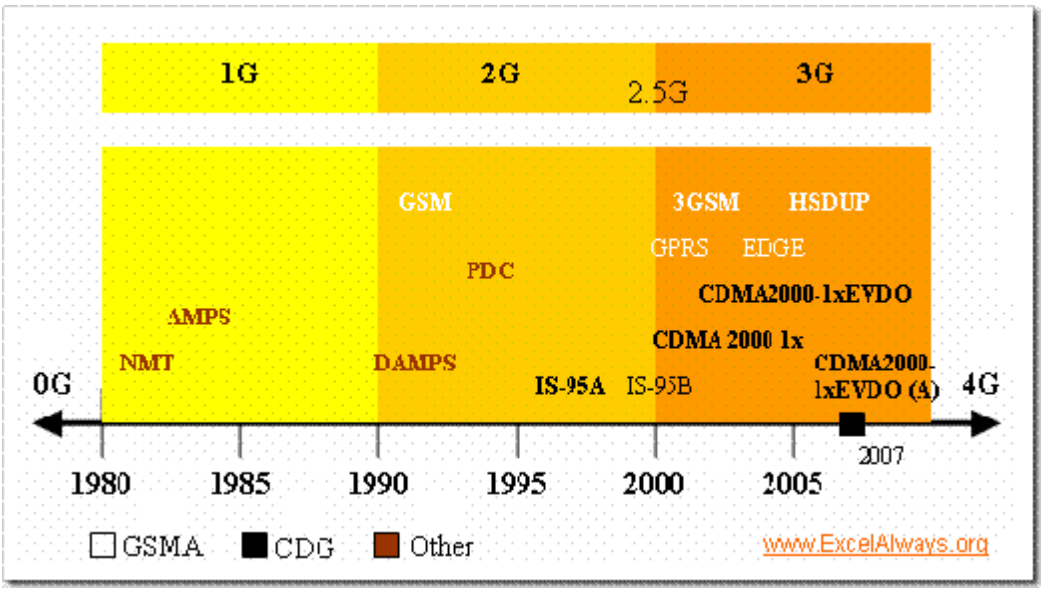

Figure 2.1: Evolution towards 3G, 4G [5].

However, digital system came in the field of technological communication, and Finally, in 1991 from the early 1990s GSM has got his first edition with the name of Global System for Mobile Communications (GSM). This technology has able to use 124 full duplex channel and it is has an able to works at 900 MHz and also this technology offers a full Roaming facility with better handover performance than before and for that Global System for Mobile Communication (GSM) has got succeed [4][6].

2.2 The Concept of Roaming System

Roaming system is a process that, have an ability for a mobile client to automatically received and send data, receive and make voice calls and it is also allow for mobile user to use other value added service when he is in a visited area which is outside the geographically coverage zone of the home network. [7]

There are mainly two types of roaming system,

a) National Roaming System: If the mobile user travels in the same country which has covered with the home network then this is called National Roaming System. From the figure 2.2, it is clear to see that, if any London mobile user wants to travel in London then his mobile will get support by the national roaming system.

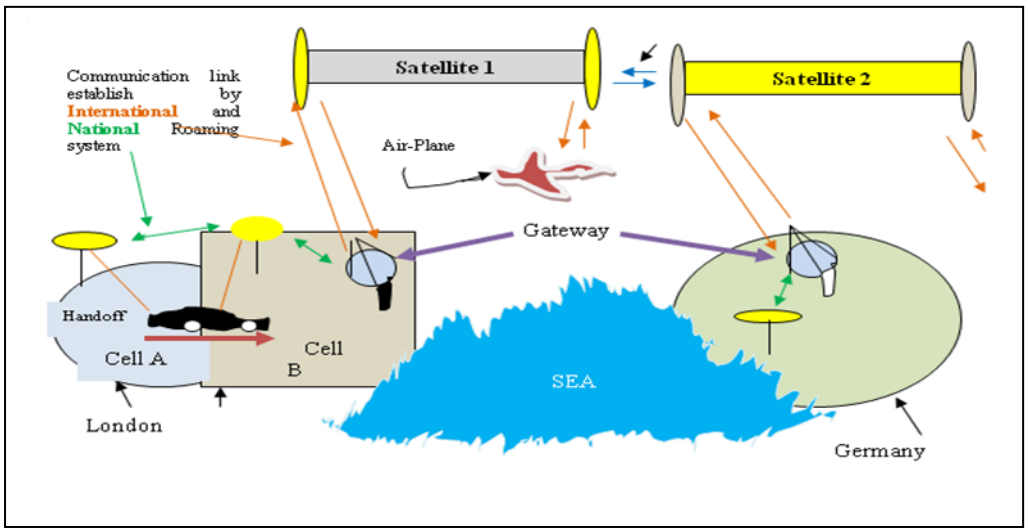

Figure 2.2: Roaming system [8]

b) International Roaming System: When the mobile user's travelling network is outside the home network then it is called as international roaming system like, from figure 2.2, if the Germany mobile user want to travel in London then he will get link by international roaming system.

2.3 The Concept of Handoff

When the mobile user continuous changes his position from one cell to another cell area, that time, this user's live call must undergo a transfer from old channel to a new channel and this has called a handoff or handover process. [9]. One hand, there are two types of handoff have found when this has measured by scenario point of view, and these two are [10]:

a) Intra-Cell Handoff

b) Inter-Cell Handoff

From the technical point of view, there are two types of handoff and these two are:

1) Hard Handoff and

2) Soft Handoff

2.3.1 Intra-Cell Handoff

Intra-Cell handoff is an easy handoff scenario which has used within a cell. Because of the physical channel is the point in weakened, the handoff has performed. It is happens by enough to below factors:

a) Determined of Bit Error Rate (BER)

b) The power level has received by telephone

This two factors' measured value has transferred by mobile phone to the base station (BS) continuously. When it is necessary to change the physical channel of a mobile phone, a new time slot and the new channel number needs to inform the mobile phone.

2.3.2 Inter-Cell Handoff

In the same network, if the mobile phone moves from one cell to another cell then inter-cell handoff happens. If It is a need to change the physical channel and assigned a new channel to the cell user from the new cell sector coverage base station (BS), then that the mobile user switch from old cell area to a new cell area.

2.3.3 Hard Handoff

When a mobile user, enter a new cell's field, and that time if his call is not assign from previous base station's channel to the current cell's channel before break down his call from the old base station's channel then this process is Hard handoff.

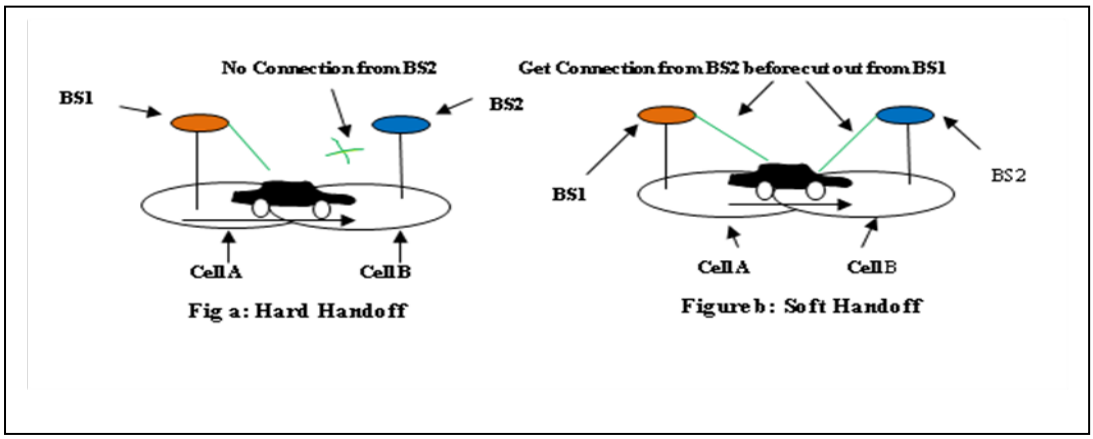

Figure 2.3.3: Hard and Soft Handoff [11]

From figure 2.3.3(a), the cell user moves from cell A to cell B, and he is not getting connection with cell B base station before break down from cell A base station. After break down from BS1 the user has got the connection from BS2 and so hard handoff is also called break-before-make technique.

2.3.4 Soft Handoff

When a mobile user, enter a new cell's field, and that time if his call assign from previous base station's channel to the current cell's channel before break down his call from the old base station's channel then this process is soft handoff. From figure 2.3.3(b), the cell user moves from cell A to cell B, and he is getting connection with cell B base station before break down from cell A base station. So, Soft handoff is also called make-before-break technique.

2.4 PROPAGATION MODEL

The model of propagation usually focused on predicting signal of receiving signal, which has to given the distance between the transmitters, besides the strength of the signal's variability in a close spatial proximity to a particular position. When it is necessitate to predicting the strength of signal, the models of propagation are useful. The important information is that, path loss can be used like a controller issue for coverage or for the performance of the system, and for that, it is achieving an idle reception. However, this section outlines to identify the distance between a base station and mobile station by the model of propagation. It has observed from the telecommunication field that, the communication of the mobile sector burdened with particulate propagation difficulties, making dependable the communication of the wireless sector difficult than the communication of fixed field between and with awarder placed antennas. In General, very small high of antenna uses on a mobile terminal. Therefore, it has expected from the antenna that, they have very little clearance. As a result, there have a substantial influence on the quality of the propagation path from reflecting surfaces, and obstacles in the surrounding of the antenna. Moreover, the characteristics of the propagation vary from position to position and also with time to the time, when the terminal moves.

2.4.1 Path Loss

The characteristics of path loss of a path (Channel) are usually necessary in the communication of wireless technologies of and the propagation of signals. There have much

cause for happening the path loss like reflection, refraction, free-space loss, diffraction, arrogation and aperture-medium coupling loss. This condition is also influence by some other reason like, environment (foliage and vegetation, rural or urban) depends the antenna's height also influenced by the distance between the transmitter (Tx) and Receiver (Rx), and propagation medium (dry or, moist air).

2.4.2 Basic propagation mechanism

The propagates of electromagnetic wave through a medium by [12],

a) Reflection,

b) Refraction,

c) Diffraction, and

d) Scattering

All of these depend on the wavelength compare to inject angle of wave, object sizes and temperature of atmospheric.

2.4.2.1 Reflection

It has found that, when the electromagnetic wave propagates, a reflection has come from the object of the environment, which is very large size than its wavelength. There are many sources that have created the reflection such as, the walls.

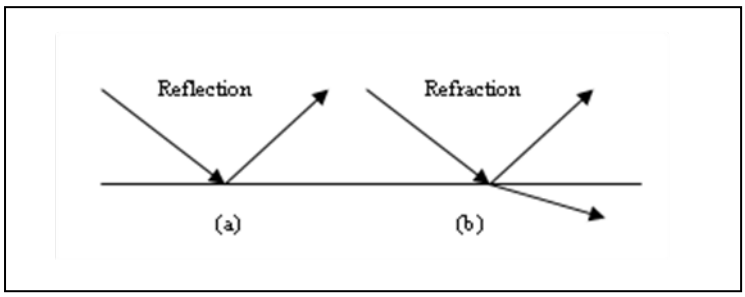

Figure (2.4.2.1): Reflection and Refraction [12]

2.4.2.2 Refraction

If the temperature, of air has changed then the atmosphere density will change, and in that situation if the wave is entering then the wave will change its direction from the original wave's path and refraction occurred.

2.4.2.3 Diffraction

From transmitter (Tx) and receiver (Rx), if the electromagnetic wave propagate then the diffraction will create, which has obstructed with a sharp edge surface [12].

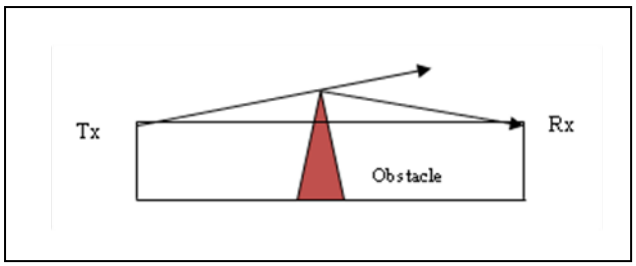

Figure (2.4.2.3): Diffraction in a sharp edge [12]

2.4.2.4 Scattering

Scattering occurs in that condition, when the wavelength is bigger than the object of the environment (<<λ) [5] such as, rain drops, foliage, rough surface.

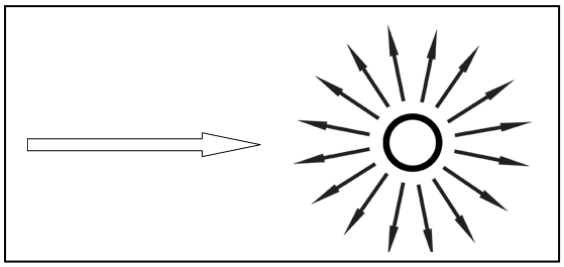

Figure (2.4.2.4): Wave is scattered by a small [12]

2.5 PROPAGATION MODEL FOR THE URBAN ENVIRONMENT

In the urban environment, there have three different types of propagation model and these are:

a) Macro cells

b) Microcells and

c) Pico cells or, indoor

From macro cells, there have high-output transmits power from the transceiver base station, and that base station has replaced above an average Rooftop, but in macro cells that located in below the average rooftop [13].

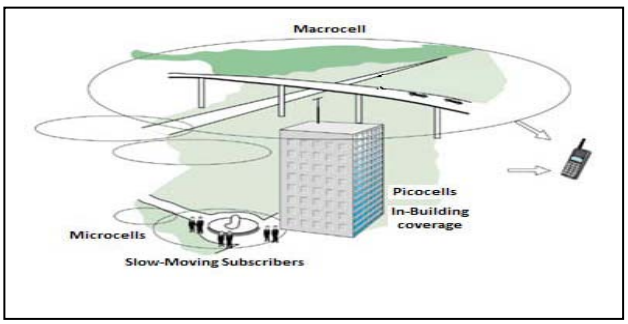

Figure (2.5): Macro, Micro and Pico cells [13]

In macro cells, the propagation environment dominated by the diffraction and reflection from streets and buildings but for macro cells over the rooftop path often dominates the propagation path. The Pico cells mean small cells and the size of that cell are only few dozen meters. Mainly indoor application has maintained by that type of cells. That type of cells can cover like airports or, shopping centre, which means that, those placed has a number of the radio antenna within one Pico cells [13].

2.6 Roaming and Handoff

There have five different classes for the range of Global System for Mobile Communication (GSM) mobile receiver and transmitter or Mobile Station (MS). Class 1 vehicle has included in here, or the radiating of portable mobile is 20W to a hand held portable unit radiating 0.8W. A Subscriber Identification Interface Module (SIM) can use these units, which can be slide-in card or can be internal.

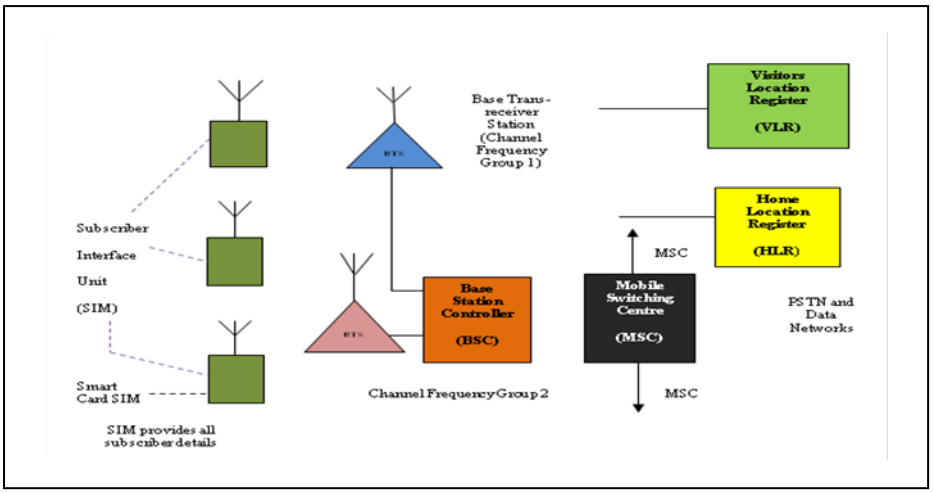

Figure 2.6: Roaming and Handoff [14]

From the above GSM network, it is clearly understood that, the handoff between BTSs and the levels of transmission power has maintained by Base Station Controller (BSC), and call management, routing and termination, call set-up, accounting and charging information, interface with PSTN and data networks has maintained by Mobile Switching Centre (MSC).This Subscriber Identification Interface Module (SIM) card holds all the customer's details. All of this information has kept on a Home Location Register (HLR). Every GSM system has also gotten that part of the information. As a result, when the mobile user wants to move to another cell, SIM tries to contact with Mobile Switching Centre (MSC). Therefore,

MSC has got to prove its validity and find the location of the mobile. International Mobile Subscriber Identity (IMSI) has used for an international mobile user. However, IMSI has connected with the MSC for confirm the SIM's validity. Mobile Switching Centre (MSC) will contact with the HLR, for collect that, subscribers register information. This information is going to the Visitors Location Register (VLR). If the information has matched, then the mobile user will get the service by the travelling network.

3. PROBLEM IDENTIFY

The cell user has got many communication advantages from the communication of mobile technology, and roaming system makes this area globally. On the other hand, traffic is one of the common barriers for roaming system. It is true that, without handoff technique, roaming system cannot give his idle performance for the cell user, but unnecessary handoff makes the cell network area busy. Therefore, this is one of the common problems for hard handoff technique.

4. METHODOLOGY AND PROCESS

It is true that traffic is one of the major problems for the cell user and therefore, it is necessary to overcome that problem. However, this paper already has discussed about the propagation model and path loss. There are several quantities for makes a pioneer handoff decision like, the level of received signal from the communicating and neighbouring base station, the rate of bit error and the strength of received signal to interference ratio. Moreover, One of the most easier and usable method has based on received signal strength. There are three kinds of variations for the strength of received signal in the land of mobile communication such as, shadowing, path loss and Rayleigh fading. This paper will take the consider only effect of the received signal strength due to the loss of the path, and in the analysis part, macro-cell atmosphere will consider by this study, and by using the model of Hata-Okumura this study will use the relating distance with the path loss.

5. ANALYTICAL METHOD

In the environment of macro cellular system, one of the most popular models for signal strength prediction is Hata-Okumura model, and that experiment model is generally valid from 150MHz to 1500MHz [15]. As a function of the distance between the Base Station (BS) and Mobile Station (MS) that model has given an experience by the path loss of the signal transmitted by the Base Station transmitter (T_{bx}) also the point for the mobile station

receiver (Rmx), and their difference function will measure between the two entities, Base station and Mobile station.

$F_c \in [50,1000]$ MHz, where, Fc= Carrier Frequency,

and H_{bs} means base station's height, and its parameter is, $H_{bs} \in [30,200]$ MHz

On the other hand, H_{hms} means mobile station's height, and its parameter is,

$H_{hms} \in [1,10]$ Km.

$D \in [1,20]$ Km, where, D= the distance between the Base Station and Mobile Station.

Now, the path loss (in db) for the urban area has got by the help of below equation [16],

PLS (db) = X + Ylog10 (D) ---------- (k)

and X and D means,

X= A fixed loss which are depending on the signal frequency.

D= distance which is measured by in kilometre.

All the above parameters have given by the empirical formula:

X= 69.55+26.16 log10 (F_c) – 13.82 (log10 H_{bs}) – a(H_{hms})

Y= 44.9 – 6.55 log10 (H_{bs})

Hence, for the measurements of the strength of receiving signal of the mobile from the Base Station, the mobile of path loss Hata-Okumura has given by [16],

PL (db) = 69.55+26.16log10 (F_c)-13.82log10 (H_{bs})-a(H_{hms})+(44.9-6.55log10(H_{bs}))log10(D)

Where,

a(H_{hms}) = correction factor (which is measured by db) for the height of mobile antenna (H_{hms}) and this has to given by the below equation,

a(H_{hms})= [1.1log10(F_c)-0.7]H_{hms}-[1.56log10(F_c)-0.8]

7. SIMULATION RESULTS AND ANALYSIS

Simulation figure (7.1) has found from the equation (k) and table (7.1 (A)) shows the path loss for various distance by using Hata-Okumura model, and all data has taken from the simulation figure (7.1).

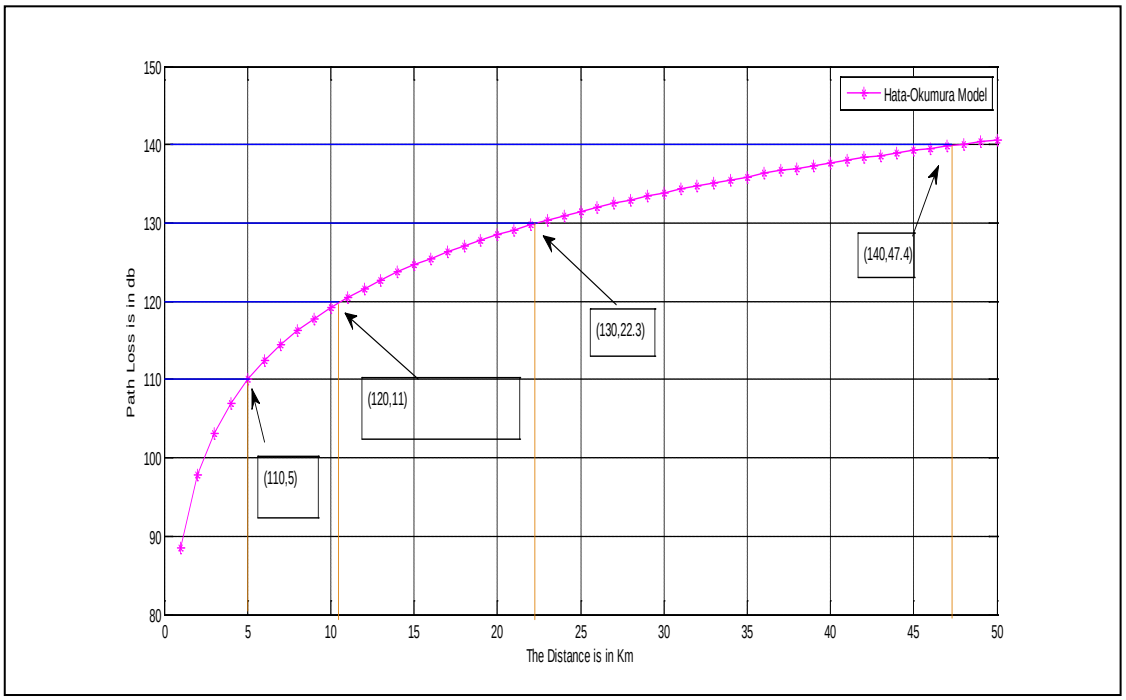

Figure (7.1): Path Loss (db) Measurements against Various Distance (Km)

Table (7.1 (A)):

Distance in Km	Path Loss in db
2.4	100
5.0	110
11	120
22.3	130
47.4	140

Table (7.1 (A)): Path loss (db) data for various distances (Km)

By figure (7.2 (A)) and figure (7.2 (B)), this paper shows the variation of mobile receiver signal which is from the base station A and base station 'B'. It is also mention that, in here the situation is involve with two condition and this are no noise and with noise.

Again the noise of Gaussian 10db which is the receiving power at A, and received power at 'B' with the noise of Gaussian 5 db. By figure (7.2), this paper shows from simulation code that, the variation of received strength of the mobile from the base station 'A' and base station 'B' when the system has no noise.

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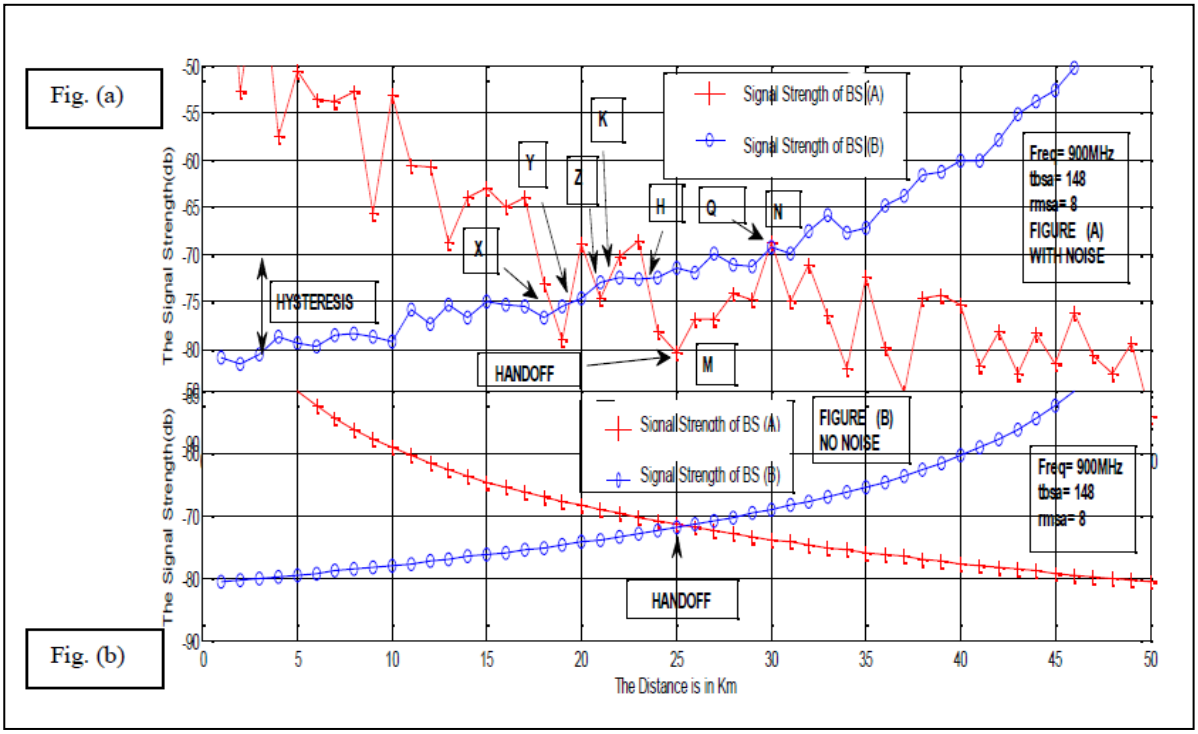

Figure (7.2 (A)): Hysteresis margir. and Handoff (with noise), Figure: (7.2 (B)) No Noise.

FIGURE: 7.2

'Ping-Pong' is one of the major problems for hard handoff which has described by this paper. However, from the figure (7.2 (A)), this paper is showing by hysteresis margin, it is possible to decrease the number of unnecessary handoffs. Therefore, From figure (7.2 (A)), it is found that, the margin of hysteresis is 10db, and without hysteresis margin there have possible to taking handoff place at X, Y, Z, K, H and Q but, by the help of hysteresis margin this figure shows that, several number of unnecessary handoff call possibility is solving by taking only two handoff place and this are M and N. Therefore, it is clear from the figure (7.2 (A)) that, "Ping-Pong" effect will be solving by Hata-Okumura model.

8. CONCLUSIONS

The main conclusions that can be drawn by the below key sentences,

1) More successful Handoff call makes the roaming system additional successful.
2) Traffic is one of the serious problems for roaming system, and this has occurred by several numbers of causes, like, unnecessary handoff and also for more unsuccessful number of handoff call.

However, this paper shows by his simulation result that, how hysteresis margin will effect positively for remove the "Ping-Pong" problem.

9. FUTURE WORKS

However, in the propagation model, it is a need to consider the effects of shadowing and fading for will be making the communication environment more realistic. This paper shows to reduce the 'Ping-Pong' effect by Hata-Okumura model but, it is also possible to continue this study by comparing with other propagation loss prediction models such as, investigation by the model of Walfisch-Bertoni and it will be possible to effect in the field of micro cellular environments, effects of street width, structure the average height of structure buildings.

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