HANDOVER IN UNIVERSAL MOBILE TECHNOLOGY SYSTEM

Nayan Mahajan[1] Jawahar Thakur[2], Arvind Kalia[3]

[2]Associate Professor, [3]Professor,

Department of Computer Science, Himachal Pradesh University, Shimla

[1]er.nayanmahajan@Gmail.com, [2]jawahar.hpu@Gmail.com, [3]arvkalia@Gmail.com

Abstract: — *This paper is concern about the study of universal mobile technology system (UMTS) and handovers. CDMA cellular network support soft handover which guarantees the continuity of wireless service and enhance communication quality. Handover means transfer of user connection from one radio channel to another. Cellular network performance depends upon soft handover. Soft handover is that in which channel in the resource cell is retained and used for a while in parallel with channel in target cell. The main goal of this paper is to show that soft handover probability can be calculated with threshold value.*

Keywords:—*Universal mobile technology system (UMTS), Handover, Soft Handover probability, Threshold.*

I. Introduction

For current need, present mobile network offer a dynamic expansion on heterogeneous network component having diverse technical characteristics. According to the user demands there should be improved service of quality, efficiency, usage friendliness and advanced telecommunication [1]. Universal mobile technology system (UMTS) gives high mobility with wide area coverage and supports low to medium data rates [2]. As there is remarkable growth in the use of wireless mobile communication, there is need a great need of management of user mobility in cellular network.The handover plays a major role in managing the mobility of the user. Different types of handover applied in different situation. When the user equipment (UE) moves from the coverage area of one cell to another cell, a wireless terminal requests a handoff for a new channel in the new cell.

In handover process cellular network automatically transfer a call from one radio channel to another radio channel while maintaining quality of service (Qos) of a call. Handover mechanism is extremely important in mobile network because of cellular architecture employed to maximum spectrum utilization. The number of cell boundaries increase because smaller cell are deployed in order to meet the demand of increased capacity. Each network resource to route the call to the next base station. If Handover does not occure at right time the QoS may drop below an adequate level and connection will dropped. The mobile monitors the strength of the base station but only the status of channel availability and network make the decision about handover [5].

By implementing soft handover (SHO) over a user, can experience quality of service (QoS) in UMTS. Because soft handover provides connection to several base station (BS) simultaneously.Thus in soft handover more than one radio links operate in parallel [3].Near the cell boundary the user equipment (UE).Is connected to more than one base station.Therefore soft handover enhance the quality of service (QoS) in cellular networks. Beside these advantages soft handover also have disadvantages that there is one or more extra connection in radio network layer, consuming additional resource and cause interference [4]. The soft handover probability is the amount of user having multiple links connection relative to the total user.
The rest of paper is organized as Section II describes the background study: pioneer era, pre cellular era, cellular era along with study of universal mobile technology system, handover and soft handover probability. It is followed by research methodology with numerical and simulation results in section III. Finally conclusion and future work is drawn in section IV.

II. Background Study

A cellular network is an asymmetric radio network made up of fixed transceivers (Node B) which maintain the signal while the mobile transceiver, which is using the network is the vicinity of the node. The is what gives the network its mobile characteristics because typically a signal could be received for data miles provided there are node to carry the signal from node to node, as the mobile transceiver as the mobile transceiver pass from area to area [6], [7].

The Background history of mobile communication can be categorized as:

- Pioneer Era
- Per-cellular Era
- Cellular Era

Pioneer Era

- 1860s James Clark Maxwell's electromagnetic (EM) wave postulates
- 1880s Proof of the existence of EM waves by Heinrich Rudolf Hertz
- 1905 First transmission of speech and music via a wireless link by Reginald Fessenden
- 1912 Sinking of the Titanic highlights the importance of wireless communication on the seaways; in the following years marine radio telegraphy is established

Pre-cellular Era

- 1921 Detroit Police Department conducts field test with mobile radio
- 1933 In the United States, four channels in the 30-40 MHz range
- 1938 In the United States, rules for regular services
- 1940 Wireless Communication is stimulated by World War II
- 1946 First commercial mobile telephone system operated by the Bell system and deployed in St Louis
- 1948 First commercial fully automatic mobile telephone system is deployed in Richmond, Virgina, in the United States
- 1950s Microwave telephone and communication links are developed

Cellular Era

- 1980s Deployment of analog cellular systems
- 1990s Digital cellular development and dual mode operation of digital systems
- 2000s Future public land mobile communication systems (FPLMTSs) / International mobile telcommunications-2000 (IMT-2000) / Universal

mobile telecommunication systems (UMTS) deployed with multimedia services.

- 2001 June NTT DoCoMo launched a trial 3Gservice.
- 2001 October NTT DoCoMo launched the first commercial WCDMA 3G Mobile Network.
- 2010s Fixed point (FP) – based wireless broadband communications and software radio will be available over the Internet
- 2010s Radio over fiber (such as fiber optic microcells) is available [8-10]

The UMTS is the third generation (3G) successor to the second generation GSM (Global system mobile) cellular technology which also include GPRS (General packet radio service) and EDGE (enhanced data rate for global evolution) standards. UMTS uses wideband code division multiple access (WCDMA) to carry the radio transmission. It employ a 5 MHz channel bandwidth. Using this bandwidth it has capacity to carry over 100 simultaneous voice cells or it is able to carry data at speed up to 2Mbps in its original format [11].

UMTS network architecture can be divided into main three elements, it includes core network (CN) domain, UTRAN (UMTS terrestrial radio access network) domain and user equipment (UE) domain. Core network is responsible for switching and routing. UTRAN consist of Node B and radio network controller (RNC) it interfaces to both UE and Core network. UE is a major element in the architecture. It firms the final interface with the user [12], [13].

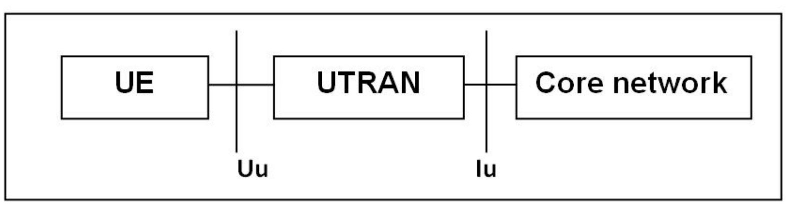


Fig 1: UMTS Architecture

The basic definition of handover means transfer of user from one radio channel to another. The main purpose of handover is to maintain an ongoing call. A Handover is generally performed when the quality of the link between Node B and UE on the move is decreasing and is possible to handover the connection to another cell with better radio characteristics [11].

Handover failure is the situation in which the handover procedure cannot be completed. The cause of handover failure ranges from signaling failure to the lack of resources in the target cell. Lots of research conducted regarding the handover failure. In the late 80's the main reason was found out because frequencies cannot be reused in adjacent cells, when the user moves from one cell to another a new frequency must be allocated for the call.

There are different types of handover in UMTS:

*Hard handover*is that where connection is broken before a new radio connection is establish between the user and radio access network. This type of handover is used in GSM cellular system where each cell was assigned a different frequency band. Hard handover also used in 3G system when it is needed to change the frequency of the carrier, either performing inter frequency handover (i.e. change UMTS carrier frequency for balancing load purpose) [14].

The *intercell handover* switches a cell in progress from one cell to another cell and the *intracell* handover switches a call in progress from one physical channel of one cell to another physical cell of same node [15]. *Soft handover* means that the radio links are added and removed in away the user equipment (UE) always keep at least one radio link to the UTRAN. Soft handover is that in which channel in the source cell is retained and used for a while in parallel with the channel in the target cell. In this scenario before the connection to the source is broken the connection to the target cell is made. This handover is called make before break. A complexity increases in the system but it has advantage like high handover success and reduction of call drop probability and elimination of inference [12-14].

Softer handover is a special case of soft handover where the radio links that are added and removed belong to same Node B. It is one of the important parameter that the probability of a user in soft handover mode. As an excessive amount of soft handover causes an overhead on system resource used, it is important to be able to set resulting in a number of handover that optimize network performance.

III. Research Methodology:

Simulation and Numerical results:

The probability can be calculated by taking the ratio of surface area of the network part where soft handover are possible, relative to the total network surface [13], [14].

SHO PROB=($A_{dark\ area}$)/ ($A_{triangle}$)

The dark area is formed by the edge of the triangle and the curve for which relation holds.

Path_loss_1" TH = Path_loss_2

Using vehicular path loss model this can be transforms to:

$33.6 \log_{10} X_1 + 120.2$ “TH $_=$ $33.6 \log_{10} X_2 + 120.2$

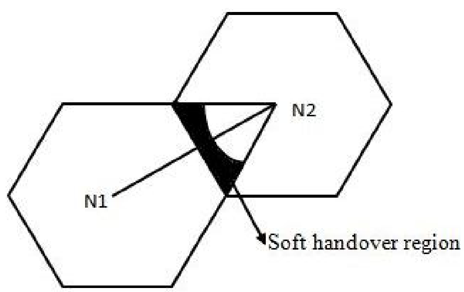


Fig 2: Soft handover area

X_1 and X_2 is the distance to N1 and N2 respectively and simplifying we get:

$$\frac{X1}{X2} = k = 10^{\frac{TH}{33.6}} \qquad \text{——1}$$

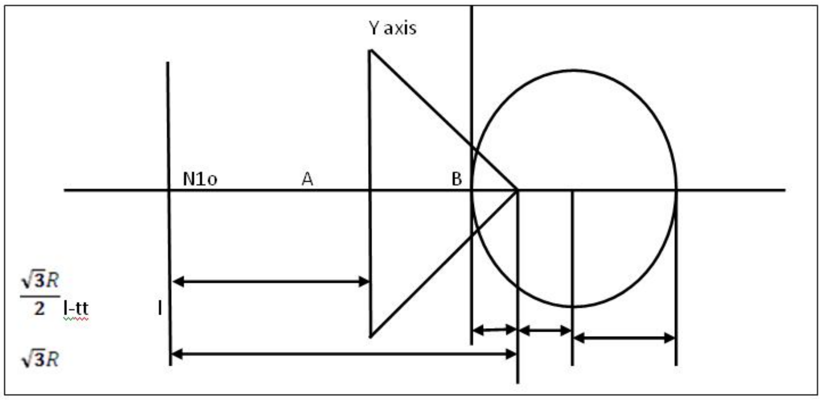


Fig3: model for soft handover probability

Expressing the relation X_1/X_2 =K we get:

$$\frac{\sqrt{3}R-(l-t)}{l-t}=K \qquad \text{——2}$$

$$\frac{\sqrt{3}R+(t+l)}{l+t}=K \qquad \text{——3}$$

R is the radius of cell and by solving 2 and 3 we get:

$$l=\frac{\sqrt{3}R.K}{K^2-1} \qquad \text{——4}$$

The surface can be integrated as:

$$2.\int_0^{OA} y.dx=\int_0^{\frac{\sqrt{3}}{2}-(l+t)}\left(R-\frac{2x}{\sqrt{3}}\right)dx \qquad \text{——5}$$

By calculating this equation:

$$R^2\left(\frac{\sqrt{3}}{4}-\frac{\sqrt{3}}{(K+1)^2}\right) \qquad \text{——6}$$

Thus soft handover probability:

$$\text{SHO PROB} = \frac{R^2\left(\frac{\sqrt{3}}{4}-\frac{\sqrt{3}}{(K+1)^2}\right)}{\frac{\sqrt{3R^2}}{4}} \qquad \text{——7}$$

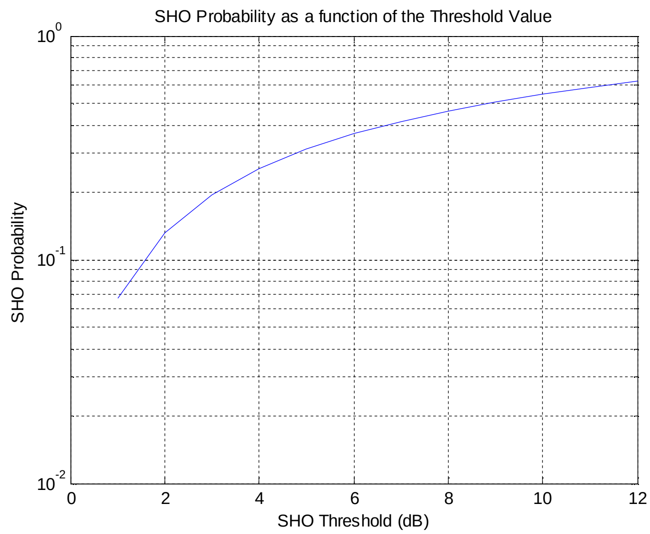
$$= 1 - \frac{4}{(K+1)^2} \qquad \text{——8}$$

Using the equation no 1:

$$\text{SHO PROB} = 1 - \frac{4}{\left(10^{\frac{TH}{33.6}}+1\right)^2}$$

Where TH represents the threshold value.

Simulation is performed in Matlab 7.0.Thus it shows that initially probability gradually increases with threshold but after the threshold value near about 8db it is almost constant. So it shows that threshold value must be set up to the value 8db for higher soft handover probability and good handover.



IV. Conclusion and Future Work:

In this paper background history of mobile communication, universal mobile technology system and handover are discussed. Further through simulation and numerically it is shown that we can find out the probability of soft handover with threshold and it is clearly seen that value of soft handover probability increases almost linearly between the threshold values 7-8 db. Thus we can conclude that threshold value must be set maximum up to 8 db.

The work may be extended by considering the different scenario for moving user (i.e. from one cell to another) and their effect on the soft handover probability.

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