# Adaptive Handover Initialization Region

**Nagwan Abdel-wahab Mohamed Khair, Ashraf Gasim Elsid, Amin Babiker A/Nabi**

***Abstract*— In mobile network the handover process is very essential and important. It allow the call continuation with high mobility. However the handover increase the signaling load and increase the mobile battery consumption. In this paper an adaptive handover Initialization region algorithm was proposed based on the overlapping region (delta) between cells. Increasing this region (delta) reduce the number of handover failure this reduction is higher for low mobility mobiles terminal. This reduction in the number of handover failure improves the performance of the mobile network.**

***Index Terms*— Cellular Network, Handover Optimization, Handover Initialization, Cell Breathing.**

## I. INTRODUCTION

Cellular networks adopt different of technologies that can help to improve the performance and increase the quality of services .One of the most important of these techniques is handover technology that able the user to mobility while ensuring continuous of contact. When mobile station moves within specific cell, the quality of connection reduce gradually and whenever it's move away from the base station serviced (because the power of the received signal is inversely proportional to the distance) The mobile station to measure the power of the received signal from the base station in the cell and base stations in nearby cells and it is delivered to the appropriate base station, and there must be in the new base station channel unused prepared for continuous contact. Handover can be in the same cell of the channel to the other channel [1].

Although in mobile network the handover process very essential and important. It allows the call continuation with high mobility. However the handover increases the signaling load and increase the mobile Battery consumption.

In Cellular systems (2G, 3G) and in particular, systems that are based on (code-division multiple access (CDMA). CDMA2000 and wideband code-division multiple access (WCDMA), There is a phenomenon known as cell breathing, which is defined as the mechanism that allows cells with heavy traffic shrink geographically and then redirect user traffic to an adjacent cell where little traffic and this so-called load balancing [2].

In this paper Handover Initialization Region will be adaptive the distance of handover region by increasing to optimize the number of handover and reduce handover failure. The paper is arranged as follows, Section II handover process; Section III related work, section IV presents the physical model and mathematical model; Section V explain Simulation Scenario ; Section VI gives the results and performance analysis; and finally Section VII concludes.

**Manuscript received August 29, 2014.**

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## II. HANDOVER PROCESS

### *A. Overview*

Cellular systems must achieve specific requirements for handover process: it should need to be the least possible and if necessary to complete the handover must be successfully and not be sensible by the user, the system determines the level of signal strength when it over the handover process is required implementation (because the quality of the connection is less). But it must make sure that the level of the signal strength has become less as a result of the movement of the mobile station and did not result in fast fading of the signal[3].

### *B. Horizontal Handover*

Handover process can be classified into two types: either horizontal handover or vertical handover, if there is handover between one type of networks that have the same access technique called horizontal handover, or there is handover between different types of networks and have different access technologies called vertical handover that sort of handover outside the scope of this paper.

Horizontal handover classified in mobile networks to handover intra cell and inter cell [4]. The intracell handover is the simplest type of delivery occurs when changing the channel assigned to the contact as a result of poor connections. The intercell handover occurs when a mobile station moves from one cell to an adjacent cell during a call that is transmitted to the new base station [5].

### *B. Channel Assignment Strategies*

For efficient spectrum management reusing the same frequency channels to support the large number of synchronous calls on mobile communication systems. There are several strategies to allocate channels including fixed channel strategy, which specifies a set of voice channels are allocated to a specific cell. The same group can reuse in another cell away from the first cell with the suitable distance appropriate to ensure that there be no overlap between the channels or be accepted.

The characteristic of this scheme is simple and is therefore used in most existing systems but the problem occurs when you increase the number of calls over a number of channels in the cell and result in an increase in the number of calls blocked. It used a strategy called borrowing channel to reduce that problem and borrow a channel from one of

adjacent cells and with ensuring that this does not conflict with existing calls on that cell and mobile switching Center oversees (MSC) to such procedures [6].
The responsibility of allocating channel resources for the mobile station is by MSC and BSs. the same set of channels can be reused in another cell far from it so as not to overlap between the channels. A simple interference can be neglected. The distance between the two cells is defined as the minimum distance can use channels a second nest is simple [7].

## III. RELATED WORK

In recent times, a large amount of research work in improved techniques for delivery of cellular networks. In [8] Proposed an algorithm known as the LTE Hard Handover Algorithm with Average Received Signal Reference Power (RSRP) Constraint (LHHAARC) this algorithm are used to reduce the number of the handover in system and reduce delays. This algorithm were compared with three well-known algorithms to minimize handover by computer simulations and their results found that this algorithm outperforms them by giving the least number of delay system less the handing of the system with improved system performance with maximum data transfer rate.

In [9] proposed two schemes to improve handover in LTE networks depending on the location of the mobile station. The first scheme used to reduce the handover by expected the target cell to be handover process and the preparation for the process of handover. As the second scheme use the mobile station location to calculate the best cell geography to complete the handover process and add parameter (RSRP) to reduce the number of handover when ((Time-to-Trigger (TTT) is small and if the (TTT) largest gives improved success rates.

In [10] Based on fuzzy logic this algorithm have been suggested and renamed Fuzzy controller for Handoff Optimization (FCHO) exploiting this algorithm features a number of available algorithms and found it removes the problem of critical impact as a result of the change in value (Threshold, hysteresis), depending on the change in (RSSI) and speed of the mobile station.

## IV. PROPOSED MODEL

### A. Physical Model

Actually a planning cells are irregular, but for simplicity we used a circular form to represent the cells of the handover process between cells in the model proposed in this paper as shown in the Fig. 1.

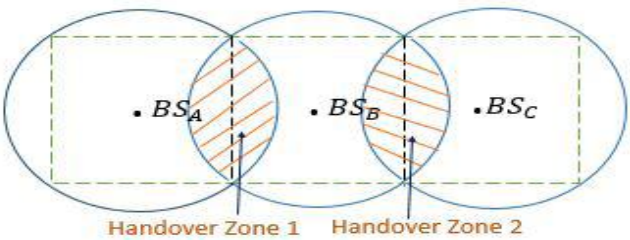


Fig. 1. Simulation Region

Assume that the window dimensions length 2Km each cell well as three cells becomes the length of the window 6Km, and width 2Km represent in Fig. 2. in the x-axis and y-axis, and assuming that the number of users in each cell 100 users distributors intracellular.

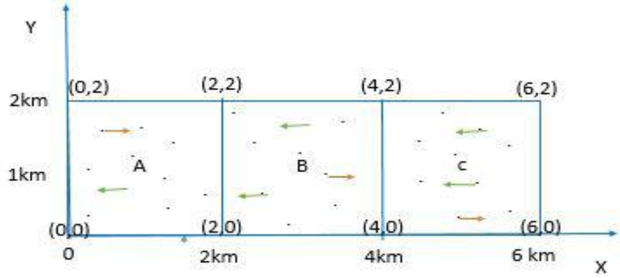


Fig. 2. Simulation area model

Take in this case the moving direction (D) either (+1) or (-1), the primary location for mobile station $(X_0, Y_0)$and delimitate the zone of handover request from $(x_{h1}$ - $delta)$ $to$ $(x_{h1} + delta)$ and the cut-off point between the cells $x_{h1}$for cells A and B. delimitate the zone of handover request from $(x_{h2}$ - $delta)$ $to$ $(x_{h2} + delta)$ and the cut-off point between the cells $x_{h2}$for cells B and C, for each mobile station show in Fig. 3.

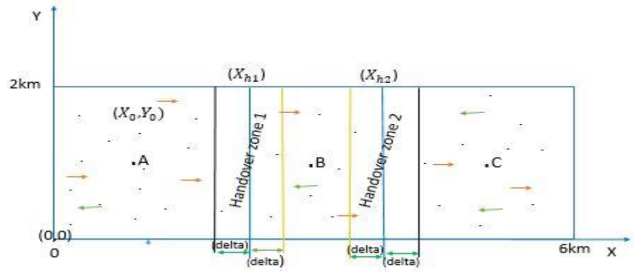


Fig.3 Handover Zone

### B. Mathematical Model

To generate random sites for mobile users in a specific area and generate access times for calls to the mobile phone. Poisson distribution is used to analyze traffic on mobile networks and is the most common use in this proposal that we use to predict the random access times for calls to random variables in discrete time periods. Poisson distribution gives the number of arrivals in the fixed period (t) and the average value(λ t) [11]:

$$P(x, t) = \frac{(\lambda t)^x}{x!} . e^{-\lambda t} \qquad (1)$$

Total displacement can be calculated from equation (2), whenever mobile station's location is$(X_c, Y_c)$.

$$\Delta d_T = \sum_{t=0}^{t=tc} \Delta d_t \qquad (2)$$

$t_c$ ≡ Time of simulation clock
$\Delta d_T$ ≡Total displacement of
$\Delta d_t$ ≡Average displacement

In the case of (D) equal (+1) means that the direction of motion from left to right and the location point $(X_c, Y_c)$ can be calculating using equation (3, 4).

$$X_c = X_0 + \Delta d_T (3)$$

$$Y_c = Y_0 + \Delta d_T \qquad (4)$$

In case mobile stations movement from left to right and the channel from the cell A. and

$$X_c < x_{h1} + delta \quad (5)$$

No need to send a request for handover or handover request equal zero. HO request = 0

As in the case of

$$X_c > x_{h1} + delta \quad (6)$$

The channel also from A, the handover process are necessary from cell (A) to cell B, so the handover is requested from cell (B) or handover request equal one. HO request = 1

But the handover success depends on the availability of free channels in cell B. However if the channel is not available in cell B handover failure occur.

Whenever the direction of motion from left to right and channel from cell B if

$$X_c < x_{h2} + delta \quad (7)$$

Not need to send a request handover or handover request equal zero. HO request = 0

As in the case of

$$X_c > x_{h2} + delta \quad (8)$$

The channel also from A, the handover process are necessary from cell B to cell C, so the handover is requested or handover request equal one. HO request = 1

But success depends on the handing over to be there in the vacant channel is not available in cell C. However if the channel is not available in cell C fail handover.

But in the opposite case when D equal (-1) means that the direction of motion from right to left and we can calculate the location point $(X_c, Y_c)$using the following equation.

$$X_c = X_0 - \Delta d_T \quad (9)$$

$$Y_c = y_0 - \Delta d_T \quad (10)$$

In case mobile stations movement from right to left and the channel from the cell C to cell B. and

$$X_c > x_{h2} - delta \quad (11)$$

Not need to send a request handover or handover request equal zero .HO request = 0

As in the case of

$$X_c < x_{h2} - delta \quad (12)$$

The channel also from C, the handover process are necessary from cell C to cell B, so the handover is requested or handover request equal one. HO request = 1

But success depends on the handing over to be there in the in the vacant channel is not available in cell B. However if the channel is not available in cell B fail handover.

Whenever the direction of motion from right to left and channel from cell B if

$$X_c > x_{h1} - delta \quad (13)$$

Not need to send a request handover or handover request equal zero. HO request = 0

As in the case of

$$X_c < x_{h1} - delta \quad (14)$$

The channel also from B, the handover process are necessary from cell B to cell A, so the handover is requested or handover request equal one. HO request = 1

But success depends on the handing over to be there in the vacant channel is not available in cell A. However if the channel is not available in cell A fail handover.

## V. SIMULATION SCENARIO

*A. Simulation assumptions*

Movement in X position only and Direction it either left or right. Assume that the movement direction is not changed during simulation.

*B. Flow chart*

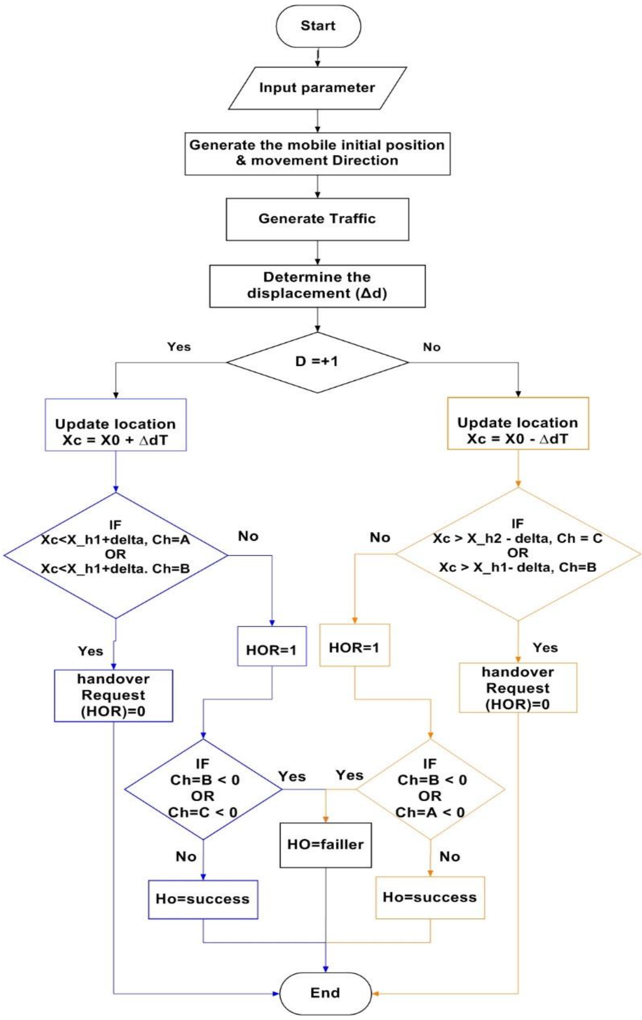


Fig. 4. Flowchart represents simulation scenario

## VI. SIMULATION RESULT

This section presents the simulation results and analysis. Fig.5.illustrate the mobile user position in cellular mobile system with random distribution, X axis represent length of simulation area (distance in meter), Y axis represent width of simulation area (distance in meter).

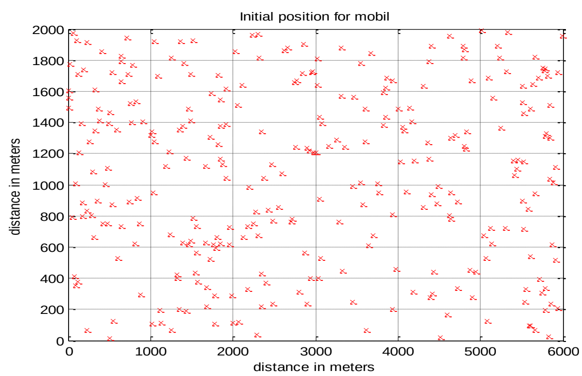


Fig.5.Initial position for mobile

Fig 6.shows the duration of (inter arrival) calls to mobile users in the proposed model, X axis represent mobile index, Y axis represent interarriva time (s).

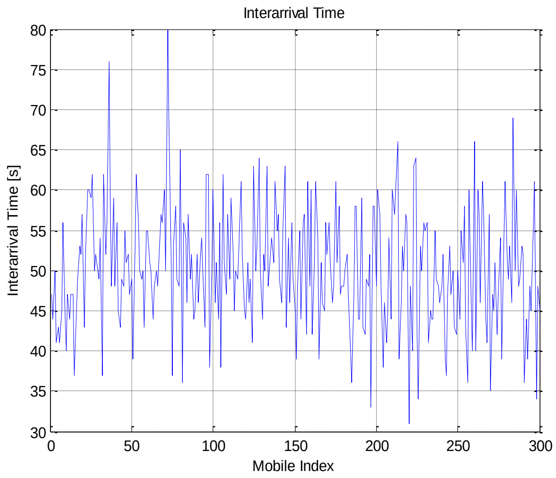


Fig. 6. Inter arrival Time

Fig. 7.shows the arrival times of calls generated by Poisson distribution in the proposed model.

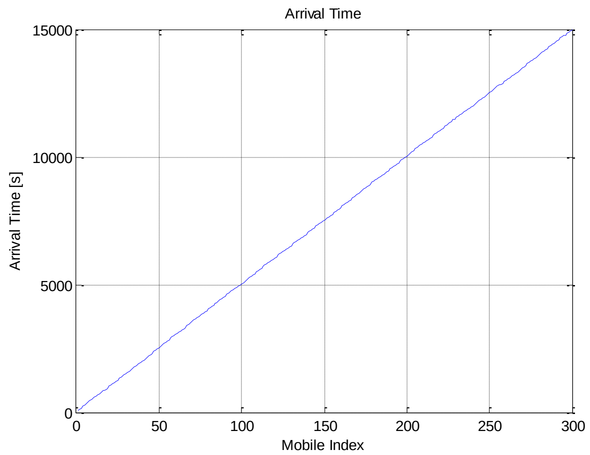


Fig. 7. Arrival Time

Fig. 8.Illustrates the call duration for users of mobile distributors randomly.

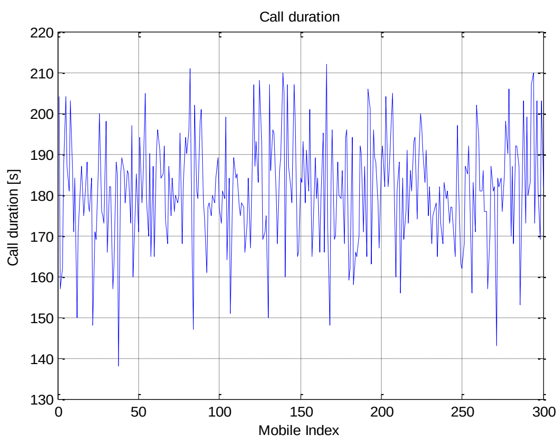


Fig. 8. Call duration

Fig. 9.illustrates relation between system traffic and handover failure when

Average Call duration = 180 s, average speed = 30 m/s, User = 100 user/cell, channel = 30channel/cell, delta = 100m

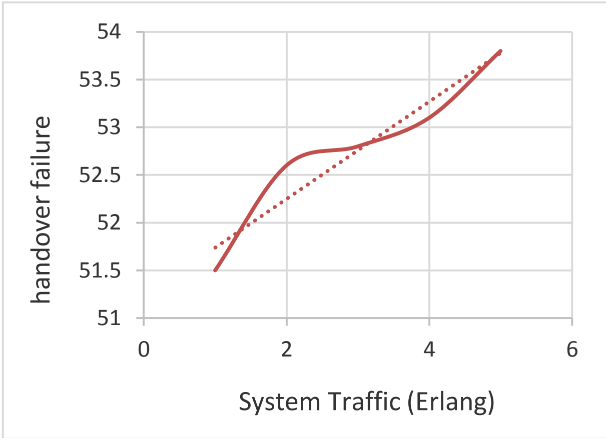


Fig. 9. Handover failure vs. system Traffic

Fig. 10, 11. illustrates relation between speed and handover failure when

Average Call duration = 180s, System Traffic = 30 Erlang, User = 100 user/cell, channel = 30channel/cell, delta = 100m.

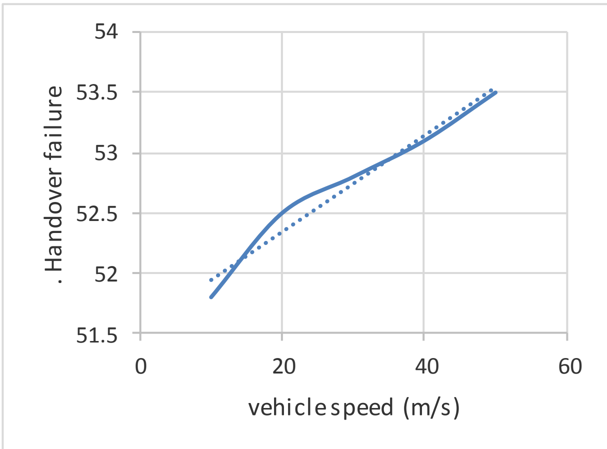


Fig. 10. Handover failure vs. vehicle speed

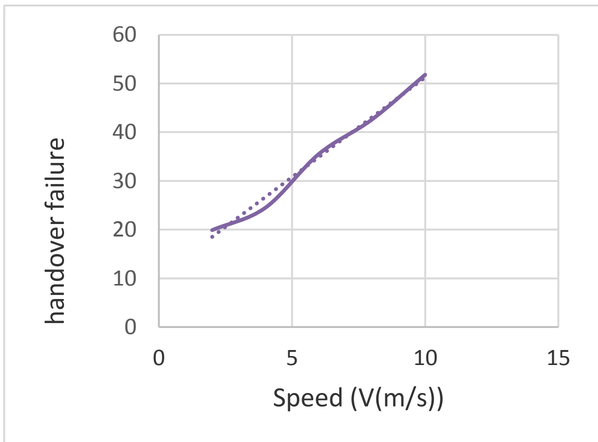


Fig. 11. Handover failure vs. walking speed

Table 1: Simulation result for Relation between Delta and handover failure

| delta | Handover failure v= 4(m/s) | Handover failure v=30(m/s) |
|---|---|---|
| 50 | 30 | 53 |
| 100 | 28 | 53 |
| 200 | 25 | 52 |
| 300 | 22 | 52 |
| 400 | 21 | 51 |
| 500 | 19 | 51 |

In table (1) simulation results show when the change in the value of the delta in normal human speed and speed of the vehicle and can clarify the relationship through figure (12).

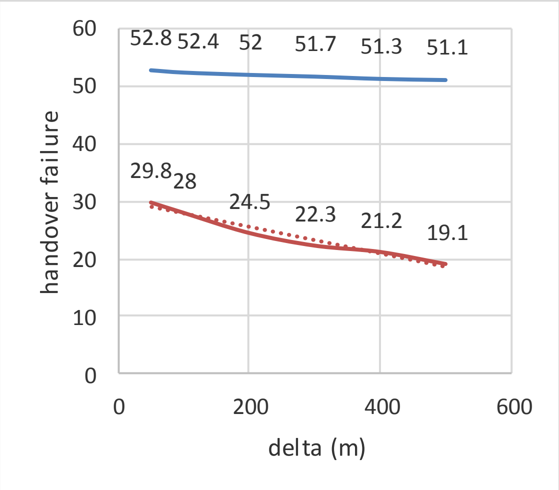


Fig. 12. Handover failure vs. Delta

By the results of the relationship between the speed in both cases (speed walk for humans and vehicle speed) found that in the case of gain increased speed increase number of handover failure.

## VII. CONCLUSION

Handover is a very important process. This paper focus on the reduction of handover failure probability. Handover consist of two phase initialization and execution. Handover initialization depends on the overlapping region (delta) between cells. Increasing this region (delta) reduce the number of handover failure this reduction is higher for low mobility of mobiles terminal .This reduction in the number of handover failure can be improved the performance of the mobile network.

## REFERENCES

[1] T. S. Rappaport, Wireless Communications Principles and Practice, 2nd ed., New Jersey, 2002. pp. 30–37.
[2] T. Dollente, "cell breathing," search mobile computing, September 2005. [Online]. Available: http://searchmobilecomputing.techtarget.com at 22/5/2014.
[3] W. Stallings, Wireless communication and Network,, 2nd ed., C. W. Networks, Ed., New Jersey, 2005, pp 266 -274
[4] A. Sgora and D. D. Vergados, "Handoff prioritization and decision schemes in wireless cellular networks: a survey,"vol. 11, no. 4, october 2009.
[5] G. Gupta and M. V. Yadav, "Different types of handover in the gsm system using matlab," vol. 1, no. 3, june 2012.
[6] D. SudarshanSubhashraoSonawane and Dr.A.K.Sachan,"Channel allocation scheme in cellular system," Advanced Networking and Applications, vol. 2, pp. 452–457, June 2010.
[7] P. Patnaik, "Fuzzy assisted handoff algorithm for micro and macro cellular system," Master, National Institute of Technology, Department of Electronics & Communication Engineering National Institute of Technology, Rourkela Orissa, India, may 2010.
[8] H. A. M. R. Cheng-Chung Lin, KumbesanSandrasegaran and R. Basukala, "Optimized performance evaluation of lte hard handover algorithm average rsrp constraint," vol. 3, no. 2, April 2011, pages 1-16.
[9] P. F. Ming FEI, "Position-assisted fast handover schemes for lte-advanced network under high mobility scenarios," vol. 20, no. 4, December 2012, pages 268-273.
[10] P. Dhand and P. Dhillon, Eds., Handoff Optimization for Wireless and Mobile Networks using Fuzzy Logic, vol. 63, no. 14, International Journal of Computer Applications, February 2013, pages. 31-35.
[11] V. B. Iversen, "Teletraffic engineering and network planning," Technical University of Denmark, Technical University of Denmark Building 343, May 2010. [Online]. Available: http://www.fotonik.dtu.dk

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