Jurnal
Teknologi

Full Paper

THE PERFORMANCE OF HANDOVER SCENARIO FOR MACROCELL AND FEMTOCELL IN LTE HETEROGENEOUS NETWORK

Article history
Received
09 June 2015
Received in revised form
23 Octrber 2015
Accepted
10 January 2016

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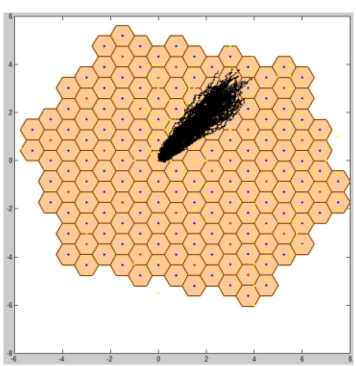
Graphical abstract



Abstract

Seamless handover process between macrocell and femtocell base stations is a major challenge of LTE femtocell-macrocell integrated system because the need of an efficient handover which can transfer User Equipment (UE) between femtocell and macrocell. The challenge facing today and future is to provide seamless handover initiation scheme and better signal strength to users because of the different LTE heterogeneous network. So, the deployment of femtocells can offload traffic from the LTE macro cellular to be managed by the femto cellular network. This research presents the handover performance when the femtocells are deployed on the macrocell heterogeneous network and also LTE femtocell-macrocell integrated network scheme for hand-in and hand-out handover process. The simulation results show a significant reduction in number of handover calls rate with the proposed scheme which can manage overloaded traffic in the LTE heterogeneous network.

Keywords: Long Term Evolution (LTE); hand-in;hand-out; Macrocell;Femtocell

1.0 INTRODUCTION

Handover is one of the important parts in wireless technologies that will become necessity trend in the near future .The investigation on handover for mobility management is necessary especially to have good service on transferring data and voice with seamless. The development and researched about handover become more rapidly and advanced with the development of technology. The term of handover refer to the procedure of transfer ongoing call or data service from one macrocell to another macrocell or femtocell when the person move around with car's speed, pedestrian user , ride bicycle or while the person walking around the building. The handover process must always occur to enable function for mobility and service continuity among a variety of wireless access technologies for example conversation like call or other services data likes short message service (SMS), email, video call and many things that can be done nowadays.

The large deployments of femtocells suffer from several challenges and the main challenge is handover. Femtocells are needed for LTE network because of coverage problem and report show that 70 to 80 percent of mobile generated at office or in the home [1]. The deployment of femtocell which used small coverage area, (10m to 25m) and UE's supported are 4 to 5 in residential and 8 to 16 for enterprise can enhance coverage in building cellular services. The LTE coverage can ensure that more users can access most of the time. There are three scenarios in handover which is macrocell to femtocell also called as hand-in, femtocell to macrocell handover called hand-out and femtocell to femtocell which called Inter Hand-off. However, in handover procedure between macrocell and femtocell there are some difficulties in selection the suitable femtocell for handover [2]. In this research, we address the issue on handling handover procedure for hand-in and hand-out.

2.0 LITERATURE REVIEW

Many recent works have been proposed in different algorithms in term of handover between macrocell and femtocell. The authors in [3] proposed handover decision algorithm by increasing the time interval between handover trigger which can reduce frequent number of handover. Reference [4] proposed pseudo code for minimizing number of handover by choosing the target femtocell with optimum RSSI and cell load to avoid unsuccessful handover and frequent handover. Authors of [5] study on various handover strategies that have been proposed and compared. They find that two parameter i.e RSSI and UE velocity are very important to mitigate number of unnecessary handover and to provide the improved quality of service to user. Another technique is proposed in [6] where the handover procedures in femtocell were considered. They used proactive handover strategy that can minimize packet loss and high latency during handover and also reactive handover to mitigate the generated handover signaling overhead that can mitigate unnecessary handover. According to [7] the handover decision policy based on mobility prediction is proposed where the handover will be postponed as long as possible until the UE reach the target femtocell.

Thus, we bring out this research in order to study and analyze the number of handover for femtocell when deployed randomly in LTE heterogeneous network. The number of handover for both types handover also has been investigating. The rest of this paper is organized as follows. First we make several literature review in Section 2 and the proposed of handover scheme in Section 3. The simulation results for the handover proposed are provided in Section 4. Finally, we give our conclusion in Section 5.

3.0 PROPOSED HANDOVER SCHEME

Fig. 1 shows the workflow of initial handover strategy for proposed handover scheme. Initially the UE is connected to the nearest macrocell or femtocell base station. When the speed of UE is set lower than 30 km/h and signal strength lower than -50 dBm, hand-in handover will take place to appropriate target femtocell. For Hand-out handover when signal strength up to -50 dBm and speed of UE is greater than 30km/h macrocell will take place. But for hand-out handover there is threshold value named as HTIH1 for Intra Handover and HTIH 2 for Inter Handover where the value is set to -56 dBm and -70 dBm to initiate handover respectively, as stated in equation (1):

$$Sdth=Pr-10*n*\log10 (R\_macro-d/R\_macro) +e1 \quad (1)$$

Where Pr is the receive signal strength, n for beta ,R_macro for radius of macrocell, d is distance UE and base station and e1 for standard deviation. This proposed handover scheme consider the velocity of the UEs and the handover type to initiate handover process. The handover threshold is the minimum levels required for the handover from macrocell to macrocell in case for intra and inter handover [8].

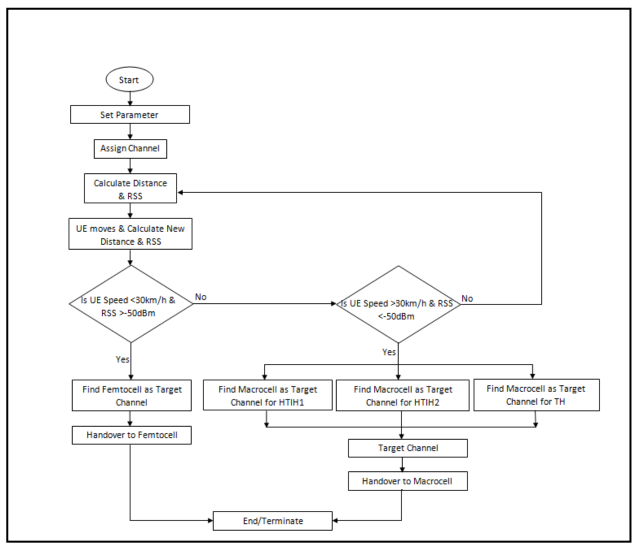


Figure 1 The workflow of proposed handover scheme

4.0 SIMULATION RESULTS, ANALYSIS, AND DISCUSSION

In this section, the effectiveness of the proposed handover scheme in terms of the number of handovers for the system model when the movements of UE are random and UE in hotspot position as in Figure 2. The simulation setup consists of an LTE macrocell-femtocell network, where the LTE networks was design with 168 hexagon cells with 168 macrocell(blue colour) base station and radius for macrocell is set 1km. For femtocell (yellow colour), there are 200 base stations and randomly deployed inside the networks. Next the simulation time was set up for 1000 seconds. Then, the resources for every base station generated and were allocated. Channel will be released by a UE after call finished. The simulation will be executed and will be terminate at the end of the simulation time. The simulation parameters based on recommendations in [9], [10], and [11], [12] have been summarized in Table 1.

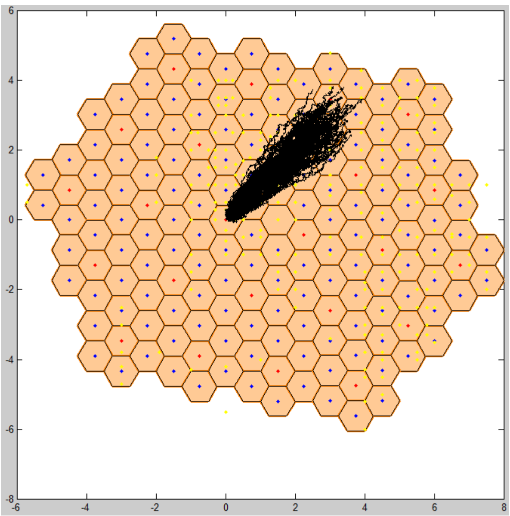


Figure 2 The movement of UE is Random & UE in Hotspot Position

Table1 The parameter that use in this research

PARAMETER	EXPLANATION
Radius of femtocell coverage area	20m
Radius of macrocell	1km
Maximum transmit power by macrocell and femtocell	40dBm and 10dBm
Propagation model for femtocell	127+30Log10(R/1000) R=distance between UE and femtocell base station in m
Velocity of the UE's	5 to 30 km/h and above 30 km/h
UE	100 UE (black line colour)

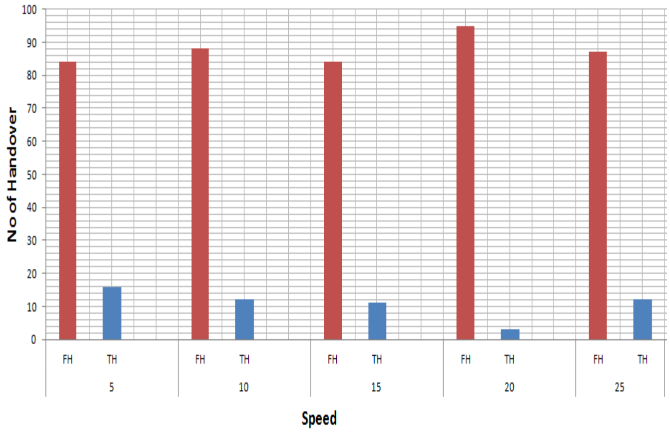


Figure 3 Number of handovers versus Speeds of UE for random movement.
FH= femtocell handover TH=Traditional handover

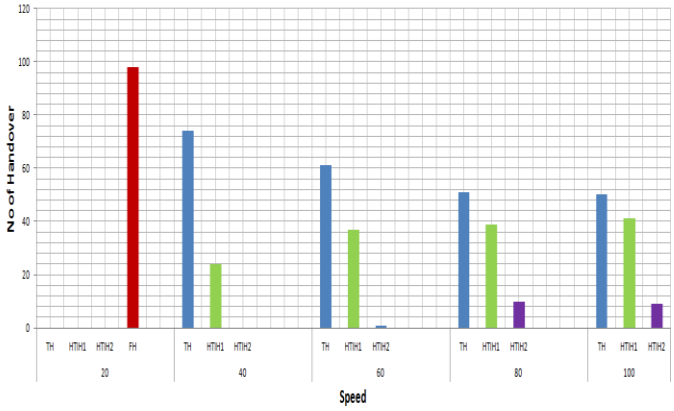


Figure 4 Number of handovers versus speed for Macrocell handover when random movement
FH= femtocell handover TH=Traditional handover HTIH1=Intra handover HTIH2=Inter handover

For Figure 3, the number of handovers was evaluated in the proposed scheme, where femtocell handover (FH) along with the traditional handover (TH) for different speeds and random number of femtocells base station. The femtocell handover is a potential mechanism for low speed (below 30km/h) to initiate handovers. The UE were assumed that they crosses femtocell until it reaches 1000s time simulation of the network. It is obvious from Fig. 3 the number of femtocell handover increase for low speed as compared to traditional handover. So from this proposed handover scheme the conversation between two UE for low speed (5km/h until 25km/h) can keeps continue. This is because of deployment femtocells and successive handovers in the proposed handover scheme as shown in Fig. 3 for hand-in handover.

For Figure 4 shows the performances of macrocell handover for hand-out handover. The number of handovers was evaluated in the proposed scheme, where HTIH1, HTIH2 along with the traditional handover and random number of femtocells for femtocell handover. The macrocell handover is a potential for high speed user (up to 30km/h) to initiate handover. From Fig 4 at speed 20 the number handover for femtocell is high (98) for low speed but when the speed increased, it shows the comparison between TH, HTIH1 and HTIH2. For TH the number of handover is between 50 until 74 but for HTIH1 and HTIH2 are between 24 until 41and 9 untill10 respectively.

The number of HTIH1 handover is more as compared to HTIH2 handover when the speed is increased because handover threshold value for Intra handover is set to -56dbm so it more close to base station and more handover can make as compared to Inter handover where the threshold value is set to -70dbm and when the speed increase up to 100km/h it quickly far from base station and make several number of handover. So this can minimize number of handover because of this proposed scheme.

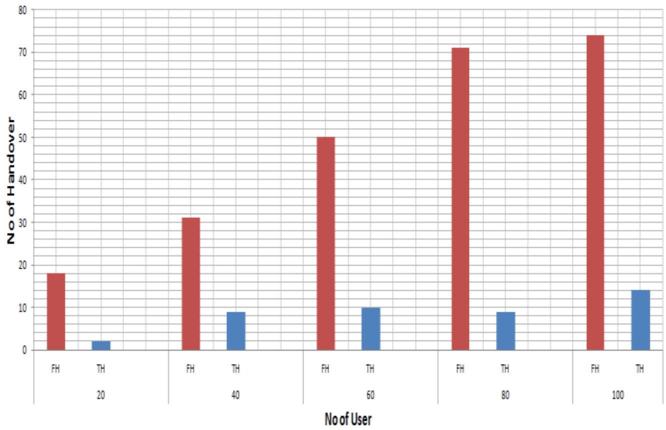


Figure 5 Number of handovers versus number of Users for hand-in handover

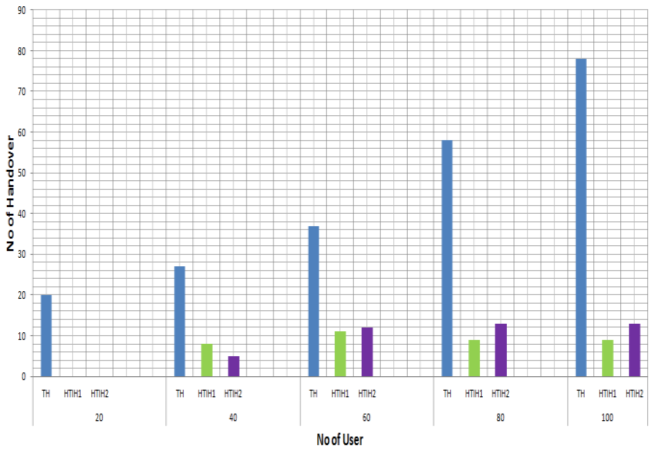


Figure 6 Number of handovers versus number of Users for hand-out handover

From Figure 5 shows the number of FH is more compared to TH from 20 users until 100 of user .This is because from the work flow we decide for low speed where below than 30km/h femtocell must initiate handover or else it pass to macrocell handover. This makes the FH as priority as compared to TH and lead to successful handover for low speed user.

Fig.6 shows that the number of TH is 20 and the number of handover increase as the number of user increased between 27 and 78. For HTIH1 and HTIH2 the numbers of handover also grow between 8 until 11 and 5 until 13 respectively.

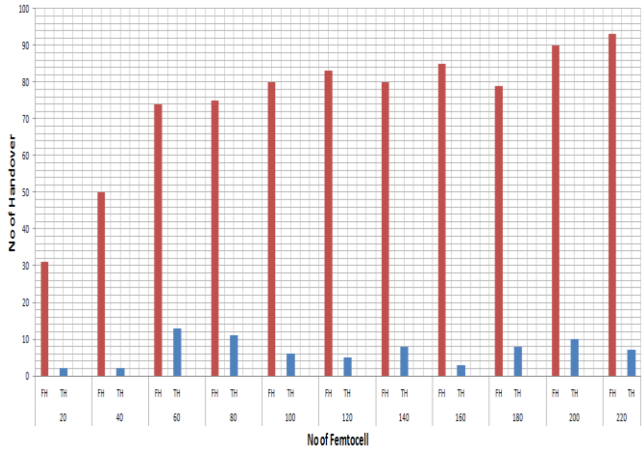


Figure 7 Number of handovers versus number of deployed femtocells

As can be seen in Figure7, the numbers of handovers increase almost linearly as the number of deployed femtocell increase. We can see that the proposed handover scheme increase the number of handovers significantly when compared to the traditional handover scheme. So, this can make UE still connected to each other and it more effectively for user in the mall or ride bicycle, pedestrian users or drive cars around the building to make calls, so number of drop called can mitigate.

5.0 CONCLUSION

In this paper the handover procedure on LTE heterogeneous network based on macrocell and femtocell has been studied and overviewed. Two scenarios are considered: hand-in, hand-out and the performance of proposed handover scheme when deployed femtocell randomly also been analyzed. The proposed handover scheme based on UE's speed and handover type where can select the appropriate base station. The proposed scheme can reduce number of handover by set the minimum level of threshold value during a call connection. To avoid probability of handover failures for lower speed user, the proposed handover scheme hands over these users to femtocell. Simulation results showed that the proposed handover scheme can minimize number of handover when compared to traditional handover for hand-out handover. So, deploying femtocell under macrocell coverage area can solve the problem of low speed users and limited coverage in building.

Acknowledgement

This paper is part of research work that was supported by FRGS grant no. FRGS/1/2014/TK03/UITM/02/5 and Faculty of Electrical Engineering, UiTM Shah Alam, Selangor, Malaysia.

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